Volume 23, Number 24 December 31, 1969

NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical Chemistry

Refer also to abstracts 50404, 50985, and 52305.

49688 INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS. Third Edition. Ewing, Galen W. New York, McGraw-Hill Book Company, 1960. 633p. $12.50.

Modern analytical instruments and techniques are surveyed. Emphasis is placed on the possibilities and limitations inherent in the various methods. Topics covered include: introduction to optical methods, the absorption of ultraviolet and visible radiation, fluorimetry and phosphorimetry, the absorption of infrared radiation, the scattering of radiation, emission spectroscopy, flame spectroscopy, x-ray methods, polarimetry and optical rotatory dispersion, introduction to electrochemical methods, potentiometry, voltammetry, polarography, electrodeposition and coulometry, conductimetry, radioactivity as an analytical tool, mass spectrometry, magnetic resonance spectroscopy, thermometric methods, introduction to interphase separations, gas chromatography, liquid chromatography, solvent extraction and related methods, electric separation methods, general considerations in analysis, electronic circuitry for analytical instruments, and laboratory experiments. (M.C.G.)

Chemical Procedures

Refer also to abstracts 49806, 49828, 49996, and 50259.

49689 (EUR-4296) SOME CONSIDERATIONS ON THE GRAVIMETRIC DETERMINATION OF THE OXYGEN TO METAL RATIO IN PLUTONIUM OXIDES AND MIXED URANIUM-PLUTONIUM OXIDES. Maurice, M. J.; Buijs, K. (European Atomic Energy Community Karlsruhe (West Germany). Transuranium Inst.). June 3, 1969. 26p. Dep. CFSTI (U. S. Sales Only).

The determination of the oxygen to metal ratio in plutonium oxides and mixed uranium and plutonium is described. The sample is weighed, equilibrated with air or a mixture of carbon monoxide and carbon dioxide respectively at 850 to 900°C, and reweighed. Results obtained with more than 130 samples were analyzed and special attention paid to the influence of the precision of the weighing on the precision of the final result. The influence of different possible types of inhomogeneity in samples is discussed. (auth)

49690 (NIM-417) DETERMINATION OF MOLYBDENUM IN URANIUM COMPOUNDS. Jones, Elaine A.; Russell, B. G.; Steele, T. W. (National Inst. for Metallurgy, Johannesburg (South Africa)). Nov. 7, 1968. 6p. Dep. CFSTI (U. S. Sales Only).

For U_3O_8, UO_3, and ammonium diuranate, the sample is dissolved in dilute nitric acid; and, for UF_4, $NaUF_4$, and UO_2F_2, a mixture of nitric acid and hydrogen peroxide is used. Ammonium thiocyanate and stannous chloride are added, and the molybdenum complex is extracted into a butyl acetate. The percentage transmittance of the colored molybdenum thiocyanate complex is measured, and the molybdenum content is read off a calibration graph. (auth)

49691 (RFP-1296) DETERMINATION OF FREE HYDROGEN FLUORIDE IN NONVOLATILE METAL FLUORIDES BY GAS-LIQUID PHASE CHROMATOGRAPHY. Ogletree, Laurence R. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). Sept. 12, 1969. Contract AT(29-1)-1106. 8p. Dep. CFSTI.

Gas-liquid phase chromatographic (GLC) determinations of hydrogen fluoride in nonvolatile metal fluorides were investigated in order to establish a direct method for free hydrogen fluoride in products from the fluoride volatility system. The GLC method is feasible for such a system, allows determinations to be performed on a routine basis, and can be adapted to the automatic operation of process streams. Hydrogen fluoride (HF) detection limits ranged from 0.008 by weight to 2.50 percent by weight. The relative reproducibility of the method on samples in the 0.01 to 0.04 percent of HF by weight range varied from 4 to 12 percent. The method, however, has a relative reproducibility of better than 4 percent on samples containing free hydrogen fluoride in concentrations of greater than 0.05 percent by weight. (auth)

49692 (RFP-1297) DETERMINATION OF MOISTURE IN NONAQUEOUS PLATING SOLUTIONS. Cichorz, Roger S. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). Aug. 29, 1969. Contract AT(29-1)-1106. 7p. Dep. CFSTI.

Water can be determined quantitatively in dimethyl sulfoxide, ethylene glycol, nonaqueous copper-plating solution and nonaqueous nickel-plating solution by measurement of the 1.94-micrometer (μm), water (H_2O) combination band. Essentially linear Beer-Lambert calibration plots are obtained for the 0.3 to 15 percent H_2O by volume range. Results of the infrared method agree within 5% relative with those obtained by an independent gas chromatographic method. The relative precision of the infrared method in the 1 to 10 percent H_2O volume range is ±1%. (auth)

49693 (RT/CHI-(68)-39) METHOD OF ISOTOPIC ANALYSIS OF URANIUM WITH A PRECISION OF APPROXIMATELY 0.1 PERCENT. Pozzi, F. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1968. 18p. (In Italian). (CONF-680456-1). Dep.

From 1st Conference on Mass Spectrometry, Ispra, Italy.

A methodology of uranium analysis with a mass spectrometer using the surface ionization technique is defined. The various parameters that affect the procedure are examined in detail from two aspects: the preparation and chemical state of the sample and the analysis conditions. The parameters examined include the quantity to be deposited, pH of the solution, preparation of filaments, deposition of the sample, emission of ions at the interior of the source, detection of the ions, and recording of the signal. The results showed that preparation of the filament carrier system is the most important effect in the first part of the analysis, although the pH and the composition of the sample are also important. The temperature and emission intensity must be controlled in the ion production phase. In the detection a Faraday cage-type detector is most advantageous. The linearity of the signal recorder must be considered in the registration phase. (J.S.R.)

49694 (RT/CHI-(69)12) DIRECT POTENTIOMETRIC DETERMINATION OF URANIUM IN THE PRESENCE OF OTHER IONS. Pompei, V.; Altamura, V.; Canonico, A. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Mar. 3, 1969. 34p. (In Italian). Dep. CFSTI (U. S. Sales Only).

A simple and rapid method is described for direct potentiometric determination of uranium with potassium dichromate in the presence of other ions by using ferrous sulfate as reductant. The sensitivity of the method is 0.3 mg of uranium for a precision of ±5%. The apparatus can be easily made remotely controlled and the method usefully employed for routine determinations for irradiated reactor fuels. (auth)

49695 (UJV-2241-CH) DETERMINATION OF RADIOCAESIUM IN FISSION PRODUCTS BY MEANS OF QUANTITATIVE AND SUBSTOICHIOMETRIC EXTRACTION WITH NITROBENZENE SOLUTION OF LITHIUM DIPICRYLAMINATE. Krtil, J.; Bezdek, M. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). Aug. 1969. 7p. Dep. CFSTI (U. S. Sales Only).

Cesium was extracted from a fission product mixture at pH ~ 8 in the presence of dilithium dihydrogen ethylenediaminetetraacetate (Li_2Y) as the masking agent, by a nitrobenzene solution of lithium dipicrylaminate. Both quantitative and substoichiometric extraction were studied. The application for analysis of a fission products mixture is illustrated. (auth)

49696 SENSITIVE INDIRECT METHOD OF COLORIMETRIC DETERMINATION OF BISMUTH WITH IODIDE. Marczenko, Zygmunt; Zoladek, Iwona; Limbach, Andrzej (Politechnika, Warsaw). Chem. Anal. (Warsaw), 14: 741-7(1969). (In Polish).

In the method developed for the determination of bismuth, the iodide complex BiI_3 is extracted from 10 N sulfuric acid. When the organic phase is shaken with dilute sulfuric acid (0.1 N), the complex is decomposed and the equivalent amount of iodide ions passes into the water phase. After oxidation with bromine to iodate an excess of potassium iodide is added. The formed free iodine reacts with starch giving a colored solution with which absorbance is measured. One bismuth atom corresponds to 18 iodine atoms which results in a high detectability of bismuth. The apparent absorptivity of bismuth is equal to 300,000. The effects of various ions on the determination was studied. Antimony, which is also quantitatively extracted, may be masked by fluoride. The preliminary precipitation of bismuth with ferric hydroxide as a carrier makes possible the concentration of traces of bismuth and separation from interfering metals. The precipitation of hydroxides is performed with ammonia or sodium hydroxide, depending on the kinds of metals which should be separated. This method has been used for the determination of traces of bismuth in chemicals of high purity (potassium sulfate, silver nitrate, and ammonium molybdate). The precision and accuracy of results is good. (auth)

49697 ABSORPTIOMETRIC DETERMINATION OF MOLYBDENUM IN NIOBIUM OR TANTALUM WITH 8-MERCAPTOQUINOLINE. Stashkova, N. V.; Suslova, S. P.; Kurbatova, V. I. Tr. Vses. Nauch.-Issled. Inst. Stand. Obraztsov Spektral. Etalonov, 3: 55-8(1967). (In Russian).

A method is described that consists of complexing the molybdenum with 8-mercaptoquinoline (8-quinolinethiol) and measuring its extinction at 425 nm against a blank. The extraction as the benzoin α-oxime complex is inapplicable with >0.01% of Mo. (TSS)

49698 CHROMATOGRAPHIC SEPARATION OF VANADIUM, MOLYBDENUM, TUNGSTEN, AND NIOBIUM FROM FLUORIDE SOLUTIONS. Fedorova, N. D.; Kurbatova, V. I.; Zolotavin, V. L.; Isupova, M. I.; Zharikova, V. K. Tr. Vses. Nauch.-Issled. Inst. Stand. Obraztsov Spektral. Etalonov, 3: 82-7(1967). (In Russian).

The following separation method is described. First dissolve the sample (0.1 to 1 g) by warming with 20 ml of HCl (1 : 1), oxidize the solution with 0.5 ml of concentrated HNO_3 and evaporate to dryness on a water bath; add 5 to 10 ml of concentrated HCl, and again evaporate to dryness. Next, dissolve the residue in 50 ml of hot 0.1 N to 0.2 N-HCl plus N-HF, cool, and pass the solution through a column of anionite AV-17 at 1 ml per min. Wash the column with 75 to 100 ml of the acid mixture to elute V(IV), Fe, Cr, Ni, and other elements. Determine V in the eluate absorptiometrically as the complex with cyanformazan-2 [3-cyano-1,5-bis-(2-hydroxy-5-sulphophenyl)formazan]. The anionite retains Mo, W, and Nb as anionic fluoride complexes. To separate Mo and W, desorb the W from the column with 500 ml of 6 N-HCl and the Mo with 200 ml of 7 N-HNO_3. To separate Mo and Nb, elute the Nb with 500 ml of 6 N-HCl, and then the Mo with 200 ml of 7 N-HNO_3; or desorb Mo with 150 to 200 ml of N-NH_4Cl–5% aqueous NH_3, and then elute Nb with 200 ml of 7 N-HNO_3. Elute W in the presence of Nb with N-NH_4Cl–5% aqueous NH_3, then elute Nb with 200 ml of 7 N-HNO_3. The method has been applied to the analysis of refractory alloys. (Referativnyi Zh.)

49699 SPECTROPHOTOMETRIC DETERMINATION OF TRACES OF URANIUM IN ZIRCONIUM AND ZIRCALOY. Onishi, Hiroshi; Toita, Yukio (Japan Atomic Energy Research Inst., Tokai). Bunseki Kagaku, 18: 1134-6(Sept. 1969). (In Japanese).

A method is described for the determination of 1 to 10 ppM of uranium in zirconium and Zircaloy. The sample is dissolved in hydrochloric and hydrofluoric acids, and the solution is evaporated to dryness. Uranium is extracted twice with 10% tributyl phosphate in carbon tetrachloride from an acid solution containing EDTA, ascorbic acid, and ammonium thiocyanate. After washing the organic phase, the uranium is back-extracted with 1M hydrochloric acid. The back-extract is evaporated to dryness, and uranium(VI) is reduced to uranium(IV) with zinc in hydrochloric acid solution. Oxalic acid and Arsenazo III are added, and the absorbance of the uranium(IV)–Arsenazo III complex is measured at 665 nm. Satisfactory results were obtained in applying the proposed method to several standard samples. (NSA of Japan)

49700 SPECTRAL AND SPECTROCHEMICAL METHODS FOR THE DETERMINATION OF IMPURITIES IN TUNGSTEN. Tarasevich, N. I.; Zheleznova, A. A.; Moreiskaya, L. V.; Kogan, O. Kh. (Moscow Univ.). Vestn. Mosk. Univ., Ser. II. Khim., No. 1, 85-9(1968). (In Russian).

The direct spectrographic determination of Cu, Ni, Co, Fe, and Cr in tungsten trioxide is carried out by using a 1 : 1 mixture of sample with carbon powder placed in a cavity in the lower electrode, and an upper cone-shaped electrode. The analytical lines (Å) are Fe 2599.4, Cu 2766.37, Cr 2843.25, Ni 3050.8 and Co 2424.9. The calibration graphs are rectilinear for the impurities named in the concentration range from 1 to 100 ppM. The sensitivity of the method for Cu and Cr is 0.1 ppM, and for Fe, Ni, and Co it is 1 ppM. For the spectrochemical determination of impurities (Cu, Ni, Co, and Cd) in tungstic acid in the concentration range from 0.1 to 1 ppM, some preliminary concentration of the impurities is necessary. The samples are analyzed spectrographically with the lines (Å) Cu 3247.54 or 3273.96, Ni 3050.82, Co 3044.02, and Cd 2288.00. The relative error is ≈30%. (Referativnyi Zh.)

49701 TITRIMETRIC MICRODETERMINATION OF GADOLINIUM: DISODIUM SALT OF RHODIZONIC ACID AS COMPLEXING AGENT. Saxena, O. C. (Univ. of Allahabad, India). Curr. Sci. (India), 38: 461-2(Oct. 5, 1969).

A method for the determination of gadolinium in microamounts is presented that consists of forming a complex between gadolinium and the disodium salt of rhodizonic acid in the ratio of 1 : 3 and then decomposing it with dilute sulfuric acid, which is then titrated against ceric sulfate solution. The range in which gadolinium was estimated varied from 3.1829×10^{-4} to 7.9573×10^{-4} mg/l, and the error was 1.2%. It was observed that 0.5 ml of 2.002 M salt solutions of Ag, Tl, Au, Co, Ni, Sc, Y, V, La, Ga, Sm, Nd, U, Zn, Zr, Th, In, Ge, and Be ions interfere. (D.H.M.)

49702 AMPEROMETRIC DETERMINATION OF ANTIMONY AND TELLURIUM OR SELENIUM IN SEMICONDUCTOR MATERIALS. Surmii, A. S.; Arishkevich, A. M.; Usatenko, Yu. I. Tr. Kom. Anal. Khim. Akad. Nauk SSSR, Inst. Geokhim. Anal. Khim., 16: 114-18(1968). (In Russian).

Of twelve dimercaptothiopyranones that give colored acid-insoluble precipitates with Sb, Se, and Te, the best reagent is 3,5-diethyl-2,6-dimercaptothiopyran-4-one (I), which is used as a 0.01 M solution in 0.3 N-KOH (standardized against a Bi salt). The titration with I solution is carried out with conventional apparatus (graphite anode), use being made of the anodic current due to I at +0.7 V (vs the S.C.E.). Antimony, Se, and Te can be titrated in H_2SO_4 or HCl medium over wide ranges of concentration. The end-point is fixed by the ratio Sb to I of 1 : 3 (in H_2SO_4 or HCl); Se or Te to I of 1 : 3 (in HCl) or 1 : 4 (in H_2SO_4). I forms more stable compounds with Se or Te than with Sb, allowing Se (or Te) and Sb to be successively titrated in a basal solution of 3.5 N-HCl. With a ratio (by weight) of Sb to Se of from 5 : 4 to 6 : 1, or of Sb to Te of from 2 : 1 to 1 : 10, the error is <±3%. The sensitivity is 2.5 μg of Sb or Te per ml, or 1 μg of Se per ml. There is no interference, in the successive titration of Se (or Te) and Sb, from a large excess of, e.g., Sn, Cr, Ni, W, Mo, Fe, or Al. The method can be used for the analysis of semiconductive Sb–Te–In and Sb–Te–Al alloys. (Referativnyi Zh.)

49703 SPECTROPHOTOMETRIC DETERMINATION OF MOLYBDENUM(V) WITH CHROM AZUROL S. Horiuchi, Yoshizo; Nishida, Hiroshi (Iwate Univ., Morioka, Japan). Bunseki Kagaku, 18: 1092-6(Sept. 1969). (In Japanese).

Chrom Azurol S (CAS) reacts with molybdenum(V) at pH 3.7 to form a blue complex with an absorption maximum at 600 mμ. The neutral solution containing 10 to 200 μg of molybdenum is transferred to a 100 ml beaker, 1 ml of 0.2M hydrochloric acid and 0.1 g of hydrazine sulfate are added to this solution and it is evaporated to about 5 ml. Four milliliters of 0.25% CAS solution is added and the pH is adjusted to 3.7 with 0.2M sodium hydroxide solution and 0.25M sodium acetate solution. After dilution to 25 ml and standing for 10 min., the absorbance is measured at 600 mμ against the reagent blank. The apparent molar absorptivity is 1×10^4. Preceding to the determination, the interferences from iron, aluminum, vanadium, etc., are removed by an extraction of molybdenum α-benzoinoximate into chloroform, and that from tungsten by an extraction of molybdenum into methyl isobutyl ketone from 6N hydrochloric acid solution followed by its back extraction into water. (auth)

49704 SPECTROPHOTOMETRIC DETERMINATION OF URANIUM(VI) WITH 2-(2-PYRIDYLAZO)-5-DIETHYLAMINOPHENOL. Florence, T. M.; Johnson, D. A.; Farrar, Yvonne J. (Australian Atomic Energy Commission, Lucas Heights). Anal. Chem., 41: 1652-4(Oct. 1969).

A spectrophotometric method for determining uranium is presented that uses 2-(2-pyridylazo)-5-diethylaminophenol (PADAP), an analog of 4-(2-pyridylazo)-resorcinol (PAR) that is almost twice as sensitive toward U(VI) as PAR with a molar absorptivity of 7.61×10^4 at pH 8.2 and 564 nm. In the presence of the mixed complexing solution it is also even more selective than PAR and because the color is developed in an acetone–water mixture, uranium can be determined directly in methyl iso-butyl ketone extracts. A study of the effects of foreign elements on the direct spectrophotometric determination of U with PADAP, showed that the only serious interferences are As(V), Cr(III), V(V), PO_4^{-3}, and SiO_3^{-2}. These interferences can be eliminated by a preliminary extraction of uranium into methyl isobutyl ketone from a $Ca(NO_3)_2$–EDTA medium. (D.H.M.)

49705 DETERMINATION OF MOLYBDENUM IN FRESH WATER: COMPARISON OF METHODS. Fishman, M. J.; Mallory, E. C. Jr. (Dept. of the Interior, Denver). J. Water Pollut. Contr. Fed., 40: No. 2, R67-71(1968).

Procedures for determining trace amounts of Mo are briefly reviewed, and a comparison was made of the results obtained for the analysis of 14 freshwater samples with dissolved solids contents ranging from 90 to 800 mg per liter. The procedures were: the thiocyanate method with isolation of Mo by ion exchange; a toluene-3,4-dithiol colorimetric method involving extraction with isobutyl methyl ketone; a modification of the atomic-absorption–toluene-3,4-dithiol extraction method of Delaughter (Atom Absorption Newsl., 1965, 4, 273) with use of a molybdenum hollow-cathode lamp at 313.3 nm; and a spectrographic method with precipitation of Mo and other metals with 8-hydroxyquinoline, tannic acid, and thionalide. The results showed that all four methods are equally reliable for natural waters and can detect as little as 1 μg of Mo per liter. (Anal. Abstr.)

49706 DETERMINATION OF TANTALUM IN METALLIC NIOBIUM. Makogonova, L. N.; Kurbatova, V. I. Tr. Vses. Nauch.-Issled. Inst. Stand. Obraztsov Spektral. Etalonov, 3: 50-5(1967). (In Russian).

A photometric method for the determination of tantalum in metallic niobium is given that involves the fusion of the sample with $K_2S_2O_7$ and extraction with ammonium oxalate. Crystal violet is added and the extinction measured at 584 nm. A variation of the procedure involves the extraction of the Rhodamine 6G–fluorotantalate complex into benzene from an oxalate–sulfate medium. (TSS)

49707 CONTROLLED POTENTIAL COULOMETRIC DETERMINATION OF PLUTONIUM AND URANIUM USING A MERCURY POOL ELECTRODE. APPLICATION TO THE ANALYSIS OF HIGH-FIRED URANIUM–PLUTONIUM MIXED OXIDES. Angeletti, L. M.; Bartscher, W. J.; Maurice, M. J. (EURATOM, Karlsruhe, Ger.). Z. Anal. Chem., 246: 297-302(1969).

A simultaneous determination of plutonium and uranium in sulfuric acid solution by controlled potential coulometry is described. After a pre-electrolysis of 0.5 M sulfuric acid on a mercury pool electrode at +0.1 V vs the saturated silver chloride electrode the sample is added to the electrolysis cell and plutonium and uranium are subsequently reduced at +0.1 V and −0.35 V, respectively. High-fired plutonium–uranium oxides are dissolved by heating with sulfuric acid, nitric acid, and ammonium sulfate. Results obtained are not biased and the precision is satisfactory. A mixed oxide pellet can be analyzed in 2.5 hours. A detailed procedure is given. (auth)

49708 CHEMICAL-SPECTRAL AND CHEMICAL-LUMINESCENCE DETERMINATION OF MICROQUANTITIES OF RARE EARTH ELEMENTS USING EXTRACTION CHROMATOGRAPHY. Shmanenkova, G. I.; Zemskova, M. G.; Melamed, Sh. G.; Pleshakova, G. P.; Sukhov, G. V. Zavod. Lab., 35: 897-902(1969). (In Russian).

Extraction chromatography with bis(2-ethylhexyl) phosphate was used for the separation of rare earth impurities from base oxides. The analysis concludes with a spectral method for determining rare earth elements in the concentrates separated from Y, La, Nd, Sm, Eu, Gd, and Yd, and a luminescence method for the concentrate separated from holmium. The sensitivity of the chemical-spectral determination of separate rare earth elements was 2×10^{-5} to 5×10^{-4}% and the sensitivity of the chemical–luminescence determination was 10^{-6} to 10^{-5}%. (tr-auth)

49709 CHEMICAL-SPECTRAL DETERMINATION OF ZIRCONIUM AND HAFNIUM USING A THREE-PHASE EXTRACTION SYSTEM. Zhivopistsev, V. P.; Makhnev, Yu. A.; Petrov, B. I.; Savina, O. I. Zavod. Lab., 35: 902-3(1969). (In Russian).

A procedure is proposed for concentrating microquantities of Zr and Hf from nitrate media by using a three-phase extraction system. The optimum conditions were determined for the extraction of the elements with diantipyrinylmethane in a mixture of chloroform and benzene in a ratio of 3:7. A procedure for the chemical-spectral determination of Zr and Hf concentrated in the third phase was worked out according to a single calibration diagram. Absolute sensitivity for Zr was 5 μg and for Hf was 9 μg. The probable error for Zr was 5.6% and for Hf was 7.4%. (tr-auth)

49710 X-RAY SPECTRAL FLUORESCENCE DETERMINATION OF NIOBIUM AND TITANIUM IN THE PRODUCTS FROM THE TREATMENT OF LOPARITE RAW MATERIALS. Rekhkolainen, G. I.; Ivanova, L. I. Zavod. Lab., 35: 936-7(1969). (In Russian).

An x-ray fluorescence method is proposed for the determination of niobium and titanium in powders and solutions from the technological treatment of loparite using an internal standard. The reproducibility of the analysis is 6 to 8% and the sensitivity for niobium was 0.1 to 0.2% (g/l) and for titanium 0.5 to 1% (g/l). The analysis of one sample required 30 to 50 min. (tr-auth)

49711 ABSORPTIOMETRIC DETERMINATION OF TELLURIUM. Murashova, V. I.; Bakunina, L. I.; Sushkova, S. G. Tr. Ural. Politekh. Inst., No. 163, 42-6(1967). (In Russian).

Tellurium is determined as a bromide complex, which, in H_2SO_4 medium, has an absorption spectrum with maxima at 320 and 442 nm. The extinction of a solution of the complex is constant with >0.2 M NaBr in 7 M H_2SO_4; Beer's law is obeyed with 2 to 40 mg of Te per ml, and there is no interference from 1000-fold amounts of Se. The test solution is evaporated (in HCl) almost to dryness (much of the Se volatilizes as $SeCl_4$) 9 ml of 8 M H_2SO_4 and 1 ml of 2 M NaBr is added to the residue, and the extinction is measured against a blank solution. The mean error is ±4%. (Referativnyi Zh.)

49712 PRELIMINARY INFORMATION SHEETS FOR ATOMIC-ABSORPTION FLAME PHOTOMETRY: NEODYMIUM AND SCANDIUM. Flame Notes, Beckman, 3: No. 1, 13-16(1968).

Tables of optimum operating conditions for the determination of Nd and Sc by atomic-absorption spectrophotometry on Beckman instruments are given. (Anal. Abstr.)

49713 THE SPECTROPHOTOMETRIC DETERMINATION OF ZIRCONIUM(IV) WITH BROMOPYROGALLOL RED. Sakai, Takayoshi; Funaki, Yuko (Hirosaki Univ., Japan). Bull. Chem. Soc. Jap., 42: 2272-5(Aug. 1969).

Zirconium(IV) reacts with an excess of bromopyrogallol red to form a violet complex. The constant absorbance of a solution containing the complex is obtained in the pH range from 5.0 to 5.4 at 760 mμ. About 25 min is required to complete the chelate formation in a boiling water bath. The complex thus formed is stable for at least 3 hr. The color system obeys Beer's law in the range from 4 to 35 μg zirconium in 25 ml. The sensitivity of the reaction is 0.002 μg per cm^2 for an absorbance of 0.001. In composition the complex has a metal-to-ligand ratio of 1:2. The molar absorptivity and the apparent formation constant of the complex are calculated to be 7.01×10^4 at 670 mμ and 1.11×10^9 at pH 5.2 respectively. The effect of diverse ions on the determination is examined. (auth)

49714 PHOTOCHEMICAL ANALYSIS. I. PHOTONOMETRIC TITRATION OF THALLIC ION BY URANYL PHOTOREDUCTION REACTION. Yokoyama, Yu; Ikeda, Shigero (Osaka Univ.). Bull. Chem. Soc. Jap., 42: 2254-8(Aug. 1969).

Photonometric titration of thallic ion is described, in which uranous ion, the titrant, is generated by photoreduction of uranyl ion in a sulfuric acid solution containing sodium lactate. Uranyl ion could be reduced with the light at wavelengths longer than 300 mμ, whereas thallic ion could not be reduced with the light in this wavelength range. Selective photoreduction of uranyl ion was accomplished by eliminating wavelengths below 300 mμ with a filter. In this photonometric titration, reaction solutions were irradiated without stirring at 29.5 ± 0.5°C. The absorbance of uranous ion produced was measured at 655 mμ every fixed irradiation time, and the absorbance was plotted against the irradiation time. Induction period, which means the period during which the absorbance remains actually zero, was in a linear relation with thallic concentration. Thus the titration of thallic ion was satisfactorily carried out in the concentration range from 0.01 to 0.1 mM. The results proved the feasibility of titration in a completely sealed container and suggest a possibility of titration on a microvolume of reaction solution. (auth)

49715 THE SPECTROPHOTOMETRIC DETERMINATION OF SCANDIUM WITH ERIOCHROME AZUROL G. Uesugi, Katsuya

(Himeji Inst. of Tech., Japan). Bull. Chem. Soc. Jap., 42: 2398-2401(Aug. 1969).

The spectrophotometric determination of scandium using Eriochrome Azurol G (sodium 2'',5'',6''-trichloro-4'-hydroxy-3,3'-dimethylfuchsone-5,5'-dicarboxylate) is described. It is based on the reddish-violet complex formation between scandium ions and Eriochrome Azurol G in a slightly acidic medium. The effects of pH, Eriochrome Azurol G concentration, temperature, and diverse ions were studied. Nine determinations of 0.5 ppM of Sc gave a standard deviation of ±0.0074 ppM or a relative standard deviation of ±1.5%. (D.H.M.)

49716 SIMULTANEOUS DETERMINATION OF PEROXYSULFURIC ACID AND CERIUM(IV) IONS. Penzes, I.; Csanyi, L. J. (Attila Jozsef Univ., Szeged, Hungary). Acta Phys. Chem., 15: 51-4(1969).

Both components of a peroxysulfuric acid and Ce(IV) reaction mixture can be determined when Ce(IV) ions are precipitated by sodium acetate and sodium fluoride quenching solution. On a macro scale after iodometric titration of peroxysulfuric acid, the Ce(IV) fluoride precipitate is dissolved in sulfuric acid, then the liberated iodine titrated with thiosulfate. On a micro scale the estimation of peroxysulfuric acid is carried out spectrophotometrically by measuring the absorption of iodine formed at 351 nm, while Ce(IV) is determined colorimetrically at 320 nm after dissolution of the precipitate. By this method 1×10^{-6} to 1×10^{-4} M peroxysulfuric acid and 1×10^{-6} to 5×10^{-4} M Ce(IV) can be estimated with ±2.5% relative error. If the total Ce concentration is to be determined, Ce(III) ions are oxidized by peroxydisulfate and the absorbance is measured at 320 nm. (BBB)

49717 ISOTOPE ANALYSIS OF NITROGEN BY EMISSION SPECTROMETRY. Leicknam, J. P. (CEN, Saclay, France). Method. Phys. Anal., 4: 319-23(Sept. 1968). (In French).

The possibility of analyzing a gaseous mixture of $^{14}N_2$ and $^{14}N^{15}N$ by optical spectrometry is well known. However, for mixtures low in ^{15}N (isotopic abundances less than 2%), the methods do not produce quickly results of sufficient precision. Operating conditions are described that allow the determination of isotopic content to ±3% near the natural abundance and to ±1% when the sample contains about 1.5 atoms of ^{15}N for 100 of $^{14}N + {}^{15}N$; the time required for a determination is approximately 10 mn; the method was employed with samples of various origins: ammonium salts, fertilizers and plant material. (auth)

49718 QUANTITATIVE ESTIMATION BY EMISSION SPECTROGRAPHY OF TRACE ELEMENTS CONTAINED IN PURIFIED CARBONS. Maillard, P.; Ades, C. Method. Phys. Anal., 4: 262-7(Sept. 1968). (In French).

Although the most rapid and the most reliable, the spectrographic analysis of impurity traces contained in purified carbons, is difficult. The difficulties result from the extremely low content of the impurities and their irregular distribution. Thus, when operating on ashes, obtained at 600°C or directly arcing on purified carbons, quantitative estimations only are obtained. (auth)

49719 CHEMICAL AND ISOTOPIC ANALYSIS OF NITROGEN COMPOUNDS BY MASS SPECTROMETRY. Mahenc, J.; Bes, R. (Univ., Toulouse). Method. Phys. Anal., 4: 272-8(Sept. 1968). (In French).

An analytical method is proposed for the simultaneous determination by mass spectrometry of the chemical composition of a gaseous mixture containing NO and NO_2 and of the isotopic content of the mixture in ^{15}N. The method is applied to mixtures of liquid nitrogen oxides. The best conditions for the handling of samples in the mass spectrometer are described. The accuracy and the reproductibility of the results are determined by analysis of samples the composition of which is settled by oxidation of NO by oxygen. The method was tested with different gaseous mixtures sampled at the different levels of an isotopic separation column. The results are in good agreement with those of the classical analytical method where the nitrogen oxides are reduced in nitrogen by copper. It is possible to get simultaneously the isotopic composition whatever be the composition in oxides. (auth)

49720 ISOTOPIC ANALYSIS OF BORON IN BF_4^- ION BY INFRARED SPECTROMETRY. Knezevic, Z. V.; Dokic, V. (Boris Kidric Inst. of Nuclear Science, Vinca, Yugoslavia). Isotopenpraxis, 5: 228-9(June 1969).

A method of isotopic analysis of boron using the ν_3 absorption band of the BF_4^- ion isolated in a potassium chloride lattice is described. The method can be used for routine isotope analysis of boron with a standard deviation of about 0.5 percentage units. (auth)

49721 EXTRACTION–PHOTOMETRIC DETERMINATION OF NIOBIUM AS MIXED COMPLEXES. Gibalo, I. M.; Altmarin, I. P.; Eremina, G. V. Vestn. Mosk. Univ., Ser. II. Khim., No. 1, 72-5(1968). (In Russian).

For the determination of Nb in pure Nb solutions, a standard solution is prepared by fusing Nb_2O_5 with a 10-fold excess of $K_2S_2O_7$ and the melt is dissolved in a 2% solution of ammonium tartrate. To a solution containing 10 μg of Nb, 0.5 ml of 2% aqueous tetramethylenedithiocarbamate, 0.3 to 0.4 ml of 50% aqueous NH_4SCN and HCl are added to give a volume of 5 ml and an acid concentration of 8 M. The solution is shaken for 1 min, and the complex is extracted by shaking for 1 min with 5 ml of $CHCl_3$. The extinction of the $CHCl_3$ layer at 410 nm is measured after 80 min against a $CHCl_3$ extract of the reagent solution. The calibration graph is rectilinear for 1 to 30 μg of Nb in 5 ml of extract. For Nb in the presence of other elements, particularly Ti and Ta, concentrated HCl to give an acid concentration of 8 to 9 M and 0.5 ml of 2% reagent solution are added to the initial solution. The solution is shaken, and the complex is extracted by shaking for 2 min with 5 ml of $CHCl_3$. 5 ml of 8 M HCl–0.3 M NH_4SCN is added to the separated $CHCl_3$ phase, the solution is shaken for 1 min, the $CHCl_3$ layer is separated, and the extinction is measured at 410 nm. Microgram amounts of Nb can be determined in the presence of a 100-fold excess of Ti or Ta or a 10-fold excess of Mn, Zn, Sn, Cd, Bi, U, Pr, Nd, Zr, P, or Cr. However, Fe(III), Cu, Co, Ni, W, and Mo interfere. (Referativnyi Zh.)

49722 ARSENATE-IODIMETRIC DETERMINATION OF THORIUM AND CERIUM(IV) IN MIXTURES. Mamedov, I. A.; Nabiev, M. N. Uch. Zap. Azerb. Gos. Univ., Ser. Khim. Nauk, No. 3, 21-4(1967). (In Russian).

For the determination of total Th plus Ce, ≃1 g of $(NH_4)_2SO_4$ is added to 20 ml of the test solution (3 to 70 mg of total Ce plus Th), then aqueous NH_3 is added dropwise so as just to form a turbidity, followed by 4 to 5 ml of H_2SO_4 (2 : 5), 10 ml of acetic acid (1 : 1), and 15 to 20 ml of 10% Na_3AsO_4 solution acidified with H_2SO_4. The solution is then heated to boiling point, the arsenates of Th and Ce are precipitated by adding 20 ml of 4 N ammonium acetate in small portions, and the mixture is heated for 1 min with stirring. The precipitate is collected, washed with 3% $(NH_4)_2SO_4$ solution (≃7 × 5 to 7 ml), then dissolved in 25 to 30 ml of H_2SO_4 (2 : 5). Next, 20 to 25 ml of benzene, 3 ml of 3 N-KI, and 25 ml of H_2O are added, and the mixture is titrated with 0.1 N $\cdot Na_2S_2O_3$ to decolorize the organic layer (titre = V_1 ml). For the determination of Ce, add 15 to 20 ml of H_2SO_4 (1 : 1) to 20 ml of the initial solution, cool, add 20 ml of benzene, 3 ml of the KI solution, and 20 ml of H_2O, and titrate with the $Na_2S_2O_3$ solution (titer = V_2 ml). The Th content is found from $V_1 - 3.66\ V_2$. Alternatively, the mixed arsenate is precipitated as above, the precipitate is dissolved in H_2SO_4, a few pieces of filter paper are added, heat to boiling point to reduce Ce(IV) to Ce(III), cool, and the total AsO_4^{3-} is titrated iodimetrically as before (titre = V_3 ml); then the volume of solution equivalent to the Ce is $V_1 - V_3$ ml. (See Analyt. Abstr., 15, 713 (1968)). (Referativnyi Zh.)

49723 CHRONOPOTENTIOMETRIC DETERMINATION OF URANIUM(III), URANIUM(IV), URANIUM(VI), AND NEPTUNIUM (IV) IN MOLTEN LITHIUM CHLORIDE–POTASSIUM CHLORIDE EUTECTIC. Caligara, F.; Martinot, L.; Duyckaerts, G. (Univ., Liege). J. Electroanal. Chem., 16: 335-40(1968).

The species named can be determined by using a platinum microelectrode. Quadri- and tervalent U can be determined in the same sample by reduction of U(IV) to U(III) and then recording an anodic chronopotentiogram for total U(III). An accuracy within ±4% is attainable for U(III), U(IV), and Np(IV) and ±6% for U(VI). (Anal. Abstr.)

Isotopic Procedures

Refer also to abstracts 50254 and 50297.

49724 A FEW EXAMPLES OF ISOTOPIC DILUTION ANALYSIS. Chenouard, J. (Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France). Method. Phys. Anal., 4: 328-30(Sept. 1968). (In French).

The examples of isotopic dilution analysis by mass spectrometry that are stated, deal more especially with analysis of irradiated fuels, for which it is of great interest to follow the evolution of the chemical composition (plutonium formation) and of the isotopic titrations (plutonium and uranium). The plutonium isotopic analyses are performed with mass spectrometers provided with solid source and electron multiplier. The accuracy is somewhat better than 1% for ^{240}Pu, a few per cent for ^{241}Pu and ^{242}Pu. The plutonium titration in uranium is performed by isotopic dilution by using a tracer containing ^{233}U and ^{242}Pu. The accuracy is close to 1%. The titration measurement in ^{235}U is performed with the help of a special-

ized for UF_6 analysis device. The relative accuracy of an analysis is 0.05%. (auth)

Radiometric Procedures

Refer also to abstracts 49880, 49921, 50163, 50195, 50826, and 51765.

49725 (BNWL-1051(Pt.2), pp 1-6) THE DETERMINATION OF TRACE LEVELS OF U, ^{230}Th, ^{210}Pb, AND ^{210}Po IN SOFT TISSUES. Jackson, P. O.; Stuart, B. O. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

A method for the determination of trace concentrations of U, ^{230}Th, ^{210}Pb, and ^{210}Po in soft tissues of animals exposed to airborne uranium ore dust was developed. The techniques were applied to such tissue samples as lung, liver, spleen, kidney, and lymph node, as well as bioassay material such as urine. (auth)

49726 (BNWL-1051(Pt.2), pp 10-13) DETERMINATION OF THE RATIO OF ^{241}Am TO ^{239,240}Pu IN SOFT TISSUES. Jackson, P. O.; Park, J. F. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

An electrodeposition procedure for the simultaneous deposition of plutonium and americium allowing precise determination of the ratio ^{241}Am/^{239,240}Pu in ashed tissue samples by means of alpha energy analysis is evaluated. (auth)

49727 (BNWL-1051(Pt.2), pp 23-7) RADIUM AND RADIO-BARIUM MEASUREMENT IN SEAWATER AND FRESH WATER BY SORPTION AND DIRECT MULTIDIMENSIONAL GAMMA-RAY SPECTROMETRY. Perkins, R. W. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

A procedure is described that permits the removal of Ra and Ba radioisotopes from seawater and freshwater on sorption beds and the subsequent direct counting of these beds on a multidimensional γ spectrometer. By use of 0.5 to 1 cm thick $BaSO_4$-impregnated Al_2O_3 sorption beds, the Ba and Ra radioisotopes can be removed at linear flow rates of up to 1 m/min. Suitable techniques for impregnating the Al_2O_3 beds with $BaSO_4$ were developed, and their efficiencies for Ba and Ra radioisotope retention were determined. The feasibility for the rapid Ra isotope separation from several thousand liter volumes of seawater and the subsequent direct counting of the sorption beds for ^{223}Ra, ^{224}Ra, ^{226}Ra, and ^{228}Ra measurements was demonstrated from sampling performed on the November 1968, cruise of the USC&GSS Surveyor between San Francisco, California, and Seattle, Washington. (auth)

49728 (BNWL-1051(Pt.2), pp 76-9) ANALYTICAL PROCEDURES USED FOR MEASURING COSMIC-RAY-INDUCED RADIONUCLIDES ^{7}Be, ^{24}Na, ^{34m}Cl, ^{38}Cl, AND ^{39}Cl IN RAIN AND AIR. Thomas, C. W.; Young, J. A.; Perkins, R. W.; Wogman, N. A. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Procedures were developed for the determination of ^{7}Be, ^{24}Na, ^{38}Cl, and ^{39}Cl in air, and ^{34m}Cl, ^{38}Cl, and ^{39}Cl in rain. The procedures described, coupled with multidimensional γ spectrometry, allow the radionuclides to be determined in the presence of greater than 10^8 dpm of Rn and Th daughters and/or fission products. (P.C.H.)

49729 (BNWL-1051(Pt.2), pp 79-82) PROCEDURE FOR THE CONTINUOUS SEPARATION AND SUBSEQUENT DIRECT COUNTING OF SHORT-LIVED COSMIC-RAY-PRODUCED RADIONUCLIDES IN RAINWATER. Perkins, R. W. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

A separation procedure has been developed for the continuous separation of the four short-lived cosmic-ray-produced radionuclides ^{24}Na, ^{38}S, ^{38}Cl, and ^{39}Cl from rainwater. The ^{24}Na is retained on a 1-cm-thick cation-exchange resin bed, while the ^{38}S, ^{38}Cl, and ^{39}Cl are retained on a 1-cm-thick anion-exchange bed. These radionuclides can be measured by direct counting of the resin beds on a multidimensional gamma spectrometer. By use of large-volume samplers which contain 28 cm diameter ion exchange beds, these radionuclides can be quantitatively removed from 1000 liters of rainwater (5×10^{-4} M in NaCl) at flow rates of 60 liters per minute. The alternate operation of two of these units will allow the desired continuous measurement of radionuclides collected on a 5000 ft^2 rain collector at our precipitation scavenging study site at Quillayute, Washington. (auth)

49730 (CEA-R-3773) ^{236}Pu TRACES DETERMINATION IN ^{238}Pu BY α SPECTROMETRY. Acena, Miguel Luis; Pottier, Raymond; Berger, Rene (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). July 1969. 37p. (In French). Dep. CFSTI (U.S. Sales Only).

Two methods are described for the determination of plutonium-236 traces in plutonium-238 by α spectrometry using semiconductor detectors. The first method involves a direct comparison of the areas under the peaks of the α spectra of plutonium-236 and plutonium-238. The electrolytic preparation of the sources is carried out after preliminary purification of the plutonium. The second method makes it possible to determine the ^{236}Pu/^{238}Pu ratio by comparing the areas of the α peaks of uranium-232 and uranium-234, which are the decay products of the two plutonium isotopes respectively. The uranium in the source, also deposited by electrolysis, is separated from a 1 mg amount of plutonium either by a tridodecylamine extraction, or by the use of ion exchange resins. Results obtained with plutonium of two different origins are discussed. (auth)

49731 (CEA-R-3774) RADIOMETRIC DETERMINATION OF THE ^{241}Pu CONTAINED IN A PLUTONIUM RICH IN 242-ISOTOPE. Pottier, Raymond; Garcia, Gerald (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). July 1969. 43p. (In French). Dep. CFSTI (U. S. Sales Only).

The determination is achieved by analytical treatment of the growth curve of ^{241}Am resulting from α-γ coincidence spectrometric measurements. The principle of the method, the mathematic formulation, the equipment used, and the chemical purification and preparation of the sources are described. Analysis was also performed for experimental verification. An attempt was made to review these results from the point of view of future improvements of this procedure. (auth)

49732 (LIB/Trans-218) APPLICATION OF GAMMA ABSORPTIOMETRY TO THE ANALYSIS OF URANIUM IN SOLUTIONS. Lavaud, Michel (Commissariat a l'Energie Atomique, Bruyeres-le-Chatel (France). Centre d'Etudes). Translated by Peter J. F. Newton (Australian Atomic Energy Commission Research Establishment, Lucas Heights), from report CEA-R-3708. 27p. Dep. CFSTI (U. S. Sales Only).

An abstract of this paper, prepared from the original language, appeared as NSA 23: 26184. (auth)

49733 (SFL-A-14) ^{222}Rn CONCENTRATION OF SOME WATER SAMPLES DETERMINED WITH GAMMA-SPECTROMETRIC MEASUREMENTS. Kahlos, H. (Institute of Radiation Physics, Helsinki (Finland)). July 1969. 34p. Dep. CFSTI (U. S. Sales Only).

Results of some gamma-spectrometric determinations of ^{222}Rn concentration in water samples measured at the Institute of Radiation Physics are presented. The sampling and measuring system is described and sources of errors in various measurements are considered. The results of measurements are given. Besides ^{222}Rn, ^{226}Ra and natural uranium were also found in some water samples. (auth)

49734 METHOD OF RADIOMETRIC ANALYSIS OF FINE SOLIDS SUSPENDED IN A LIQUID. Starnes, Peter Edward (to Hilger and Watts Ltd.). U. S. Patent 3,469,095. Priority date Apr. 8, 1964, Great Britain.

A method of carrying out radiometric analysis of fine solids suspended in a liquid in which the density of the suspension is first deduced by causing the suspension to interact with a beam of electromagnetic radiation the photons of which principally have energies in the range 600 to 3000 keV and by measuring the intensity of the radiation transmitted through the suspension for comparison with similar measurements on a reference standard. Thereafter the suspension is irradiated in an analysis chamber and the resulting radiation measured for comparison with similar measurements on a reference standard. (Offic. Gaz.)

49735 DEUTERIUM ANALYSIS BY PHOTONEUTRON DETECTION. George, Kenneth D.; Kramer, Henry H. (Sterling Forest Research Center, Tuxedo, N. Y.). Nucl. Appl. Technol., 7: 385-8(Oct. 1969).

Apparatus for the detection and measurement of small amounts of deuterium in small-sized samples by the photoneutron reaction is described. With a 25-Ci ^{24}Na gamma source, a net response of 7 counts/min per microgram of deuterium in sample sizes from 0.1 to 1.0 ml is obtained. The lower detection limit in such samples is about 1.7 micrograms of deuterium, or the amount in 0.05 ml of natural water. (auth)

49736 COUNTING OF ^{42}K BY CHERENKOV RADIATION. Johnson, J. E.; Hartsuck, J. M. (Harvard Medical School, Mass.). Health Phys., 16: 755(June 1969).

Detection and measurement of ^{42}K is usually by use of Na I (Tl) scintillation counting; this is not entirely satisfactory, however, since the 1.52 MeV γ ray is emitted in only 18% of the disintegrations. It was observed that ^{42}K in aqueous extracts of biological samples can be counted with about 80% yield by liquid scintillation counters, but a major limitation of this method is immiscibility of the aqueous sample in the fluor organic solvent. It was subsequently found, however, that the counting efficiency was nearly as high when the fluor was omitted. The light produced was then

Cherenkov radiation due to the interaction of the 3.54-MeV β particle of ^{42}K with the water medium. The counting yield was about 60%, and the background was lower. The method allows up to 20 cc of the aqueous sample to be counted without any previous preparation. In potassium kinetic studies the larger sample size allowed observations of ^{42}K activity in human plasma or urine for 2 to 3 additional days. The threshold for the Cherenkov effect is about 0.3 MeV; ^{42}K may therefore be counted in the presence of ^{14}C, ^{3}H, or other weak β emitters with no energy discrimination necessary. A nearly linear quench correction curve was obtained by the channel's ratio method. (UK)

49737 SEPARATION AND DETERMINATION OF MICRO QUANTITIES OF Po IN BIOLOGIC PRODUCTS BY ELECTROCHEMICAL DEPOSITION. Furnica, G.; Toader, Maria (Institutul de Igiena, Bucharest). Igiena (Bucharest), 18: 227-32 (Apr. 1969). (In Rumanian).

Various methods for the estimation of Po in biological materials are briefly considered, including complexometric, chromatographic, electrophoretic, and ion exchange techniques. An electrochemical method is proposed which is simple and sensitive to micro amounts of Po, and was carried out using ^{210}Po. The normal potentials of Ni (−0.25 V) and Po (+0.77 V) permit separation, on Ni disks, of Po from acid solutions by internal electrolysis (electrochemical substitution). A better recovery rate (95 ± 3%) of 4×10^{-11} g amounts of Po was obtained by maintaining the Ni disks in a $PoCl_4$ solution. The determinations were done radiometrically by measuring γ radiation in an FH-51 proportional counter with CH_4 circulation. Several factors that might influence the deposition of Po on the Ni disks were also studied, such as temperature, acid concentration, surface qualities of the disk, contact time, and presence of foreign molecules or ions. The optimal conditions are: an electrolytic interval of 3 hr, 90°, 0.1 to 1.0 N HCl-cleaned disks. The electrochemical deposition reaction was standardized by means of Amersham ^{210}Po standard solutions. Application of the Po deposition reaction on Ni disks to a series of products permitted determination of microamounts of ^{210}Po in water, biologic products, and tobacco. (BBB)

49738 METHOD FOR THE DETERMINATION OF ^{32}P IN WATER AND URINE. Furnica, G.; Ionescu, Maria (Institutul de Igiena, Bucharest). Igiena (Bucharest), 18: 105-11(Feb. 1969). (In Rumanian).

A method was developed for the determination of radiophosphorus (^{32}P) in water and urine, by isolation of ^{32}P in the form of phosphate anion, which is then precipitated as ammonium phosphomolybdate. To carry out the method, a 15 ml aliquot of a 24 hr urine sample is treated with 6M ammonia in a 200-ml centrifuge tube. The precipitate is redissolved in concentrated HNO_3, and the solution heated to 60°C. Ammonium molybdate solution (50 ml) is added, the precipitate dissolved with ammonia, and purified by reprecipitation several times. A Va-Z-310 or FH-51 counter is used to measure ^{32}P in the precipitate. With ~100 μCi amounts of ^{32}P, giving cpm values of 10,000 to 13,000, it is possible to obtain a separation efficiency of 70 to 97%. This efficiency varies with the activity of the sample analyzed. Satisfactory results were obtained for determinations in water and in urine contaminated artificially, or from persons contaminated with ^{32}P. (BBB)

49739 OXYGEN FLASK COMBUSTION ANALYSIS OF ^{14}C AND ^{3}H: DESCRIPTION OF METHOD AND APPARATUS AND SUMMARY OF EXPERIENCE, WITH EMPHASIS ON ANALYSIS OF LOW LEVELS OF ACTIVITY. Ober, R. E.; Hansen, A. R.; Mourer, D.; Baukema, J.; Gwynn, G. W. (Parke, Davis and Co., Ann Arbor, Mich). Int. J. Appl. Radiat. Isotop., 20: 703-9 (Oct. 1969).

Procedures and equipment used for oxygen flask combustion analysis of biological samples containing ^{14}C and ^{3}H are described. The method combines features of earlier, basic methods described by Kelly et al. and by Kalberer and Rutschmann and contains some of the more recent modifications of these basic methods. Emphasis is placed on features of the method that may be of particular interest in situations where capacity for efficient handling of large numbers of samples and reliability at low radioactivity levels are important factors. (auth) (UK)

49740 AUTORADIOGRAPHIC DETECTION OF ^{131}I USING POLAROID FILM. Jackson, D. D. (Los Alamos Scientific Lab., N. Mex.); Kahn, M. Int. J. Appl. Radiat. Isotop., 20: 742-3(Oct. 1969).

A system of autoradiography has been devised employing Polaroid 4 × 5 film packets which does not require a darkroom and makes it possible to get a positive print showing the location of the activity within a minute after completing the exposure. Dried chromatography paper, containing the activity, is taped in position on the film packet. Approximately 0.001 μc of iodine-131 was found to be necessary to give an easily discernible spot on the film after 16-hr exposure. (UK)

Activation Procedures

Refer also to abstracts 49932, 50237, 50262, 50295, and 50684.

49741 (BNWL-1051(Pt.2)) PACIFIC NORTHWEST LABORATORY ANNUAL REPORT FOR 1968 TO THE USAEC DIVISION OF BIOLOGY AND MEDICINE. VOLUME II. PHYSICAL SCIENCES. PART 2. RADIOLOGICAL SCIENCES. Nielsen, J. M. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). June 1969. Contract AT(45-1)-1830. 234p. Dep. CFSTI.

Fifty-eight articles are included; separate abstracts were prepared for 51. The remaining articles contain information on flash photolysis, endothermic measurements, and endothermic processes in tissue-equivalent plastic. Eleven articles are included as abstracts only and were not included in NSA. (P.C.H.)

For abstracts of individual papers see: 49725–49729, 49742–49749, 49766, 49815–49817, 49879, 49880, 49943–49949, 49960–49966, 49989, 50105–50110, 50162, 50163, 50173, 50174, 50267, 50268, 50395, 50396, 50456, 50650, and 51387.

49742 (BNWL-1051(Pt.2), pp 6-9) MULTIELEMENT ANALYSIS OF HUMAN LUNG TISSUE. Rancitelli, L. A.; Perkins, R. W.; Renzetti, A. D. Jr. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Human lung tissue obtained from individuals with experience in copper ore processing, uranium mining, uranium processing, and heavy metals processing were analyzed by instrumental neutron activation analysis. The concentrations of 19 elements are reported in the lungs of these individuals and are compared with the concentrations measured in a normal individual. The uranium miner was found to have 2 ppm U and the uranium processor 27 ppm U, compared to 0.001 ppm U in the normal individual. The lung from the subject with a heavy element exposure had a normal uranium concentration but contained 8 times the normal Th. (auth)

49743 (BNWL-1051(Pt.2), pp 53-8) TRACE ELEMENT CONCENTRATIONS IN ATLANTIC OCEAN WATERS BETWEEN FLORIDA AND IVORY COAST, AFRICA. Robertson, D. E.; Prospero, J. M. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Neutron activation and direct γ-spectrometric techniques were employed in the measurement of the trace elements Sr, Cs, U, Sb, Co, Sc, Zn, and Fe in Atlantic Ocean seawater samples collected between Florida and Ivory Coast, Africa. Slight variations in the concentrations of the conservative elements Sr, Cs, U, and Sb were observed. Although the concentrations of these elements were, in general, closely related to the salinity of the seawater, small but significant localized variations in the Sr/salinity, Cs/salinity, U/salinity, and Sb/salinity ratios were observed. The concentrations of Co, Zn, and Fe were highly variable and apparently dependent upon the biological activity in the water. Scandium is rapidly depleted from the oceans and is present in extremely low concentrations. (auth)

49744 (BNWL-1051(Pt.2), pp 59-63) DISTRIBUTION OF SIXTEEN TRACE ELEMENTS IN PELAGIC SEDIMENT CORES FROM THE SOUTH PACIFIC OCEAN. Robertson, D. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Neutron activation and direct γ-spectrometric techniques were employed in the measurement of the trace elements Fe, Na, Sr, Mn, Cu, Cr, La, Ce, Sc, Th, Co, Hf, Sb, Yb, and Eu in pelagic sediment cores collected in the Tasman Sea area of the South Pacific Ocean. The majority of the sediments were of a calcareous composition, and their trace element content differed markedly from the deep-sea red clays predominantly found in the North Pacific Ocean. Several cores were spectacularly stratified with sediments of diverse origin, and the trace element composition of these layers provides a better understanding of the behavior of the oceans' trace elements during the various processes that lead to sedimentation and mineral formation on the ocean floor. (auth)

49745 (BNWL-1051(Pt.2), pp 131-4) NEUTRON ACTIVATION ANALYSIS OF A STANDARD PLANT MATERIAL. Rancitelli, L. A. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

A standard biological reference material prepared from kale was analyzed by direct instrumental neutron activation analysis. The concentrations of 13 elements were measured in each of eight samples with excellent precision. The concentrations of potassium, sodium, iron, rubidium, zinc, bromine, chromium, cobalt, and antimony agreed very well with previously-reported values. The cesium content was somewhat higher than previously-published

values, while large discrepancies occurred between the silver, scandium, and mercury concentrations reported in this paper and results reported elsewhere. (auth)

49746 (BNWL–1051(Pt.2), pp 135-7) TRACE ELEMENT CONCENTRATIONS IN THE ATMOSPHERE. Rancitelli, L. A. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The concentrations of cesium, cobalt, iron, and scandium have been measured in the atmosphere using a technique of instrumental neutron activation analysis. High purity cellulose air filters were used to sample air at altitudes from 10,000 to 50,000 ft. The scandium content decreased by two orders of magnitude from 10,000 to 50,000 ft, while the iron concentration showed an eightfold decrease over the same altitude increment. The relative atmospheric concentrations of iron, cobalt, scandium, and cesium at 50,000 ft were compared with terrestrial meteoritic abundances. Preliminary indications are that the major portion of material collected is of terrestrial origin. (auth)

49747 (BNWL–1051(Pt.2), pp 137-41) MULTIELEMENT ANALYSIS OF COLUMBIA RIVER WATER BY NEUTRON ACTIVATION AND CHEMICAL SEPARATION TECHNIQUES. Rancitelli, L. A.; Tanner, T. M. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

An analytical method capable of determining nineteen elements in river water by use of neutron activation, group-chemical separations, and gamma analysis is described. The elemental concentrations of Na, K, Rb, Cs, Sc, Cr, Mn, Fe, Co, Cu, Ag, Au, Zn, Hg, As, Sb, Se, Br, and U were measured and the observed variations compared with previous work. Several trace element variations in the Columbia River appear to be related to seasonal changes. (auth)

49748 (BNWL–1051(Pt.2), pp 142-6) ELEMENTAL CONTENT AND RETENTION OF A RAINBOW TROUT. Rancitelli, L. A.; Tanner, T. M.; Dean, J. M. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The soft tissues, internal organs, blood, and food of a fish raised under controlled conditions were analyzed by a multielement technique of neutron activation analysis. The concentrations of Na, K, Rb, Cs, Br, Zn, Se, Co, Fe, Cr, Sc, Sb, Ag, and Hg are reported in the midline muscle, dorsal muscle, brain, spinal cord, liver, heart, spleen, kidney, blood, and food of a rainbow trout. Silver concentrates primarily in the liver (0.4 ppM), Cr and Sb in the kidney (12 ppM and 0.007 ppM, respectively), and Sb in the liver (0.006 ppM). The food contains 200 to 1000 times more Sc than any tissue of the fish. Several organs accumulated more than 1 ppM Hg even though less than 0.1 ppM Hg was found in the food. The Rb/K and Cs/K ratios varied throughout the fish and showed large departures from the ratios in the food. The Rb/Na + K and Cs/Na + K ratios based on chemical equivalents of each element were relatively constant throughout the fish and compared quite well with the ratios in the food. (auth)

49749 (BNWL–1051(Pt.2), pp 146-51) MULTIELEMENT ANALYSIS OF PACIFIC SALMON TISSUE. Rancitelli, L. A. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Samples of each species of Pacific salmon were collected, their dorsal muscle and liver tissue analyzed by instrumental neutron activation analysis, and the concentrations of the 14 elements Na, K, Rb, Cs, Br, Zn, Fe, Cr, Co, Se, Hg, Ag, Sb, and Sc measured. Sockeye salmon liver had the highest Se (48 ppM) and Ag (6.4 ppM) content of the five species, while the Silver salmon liver had the highest Co (0.21 ppM) content. The analysis of seven Chum salmon, four male and three female, revealed several variations that can be correlated with sex. The male liver contained an average Se content of 21.3 ± 3.3 ppM and Ag content of 5.8 ± 0.5 ppM, while the female liver contained 10.5 ± 2.5 ppM Se and 3.8 ± 1.0 ppM Ag. The total Se inventory of the female Chum salmon was equal to that of the male if the Se concentration of the roe was taken into consideration. The Cs concentration relative to K is reported for all salmon and compared with the values in seawater. All salmon were found to preferentially concentrate Cs to varying degrees. The Silver salmon had a Cs/K ratio in the muscle tissue of 12.9×10^{-6} compared with a ratio in seawater of 0.8×10^{-6}. The Rb/K ratio was found to be lower in the muscle than in the liver for all species, but the deviation from the value in seawater was small. (auth)

49750 (NYO–2174-96) TRACE ELEMENT CONCENTRATIONS IN SOME MODERN CORALS. Livingston, H. D.; Thompson, Geoffrey (Woods Hole Oceanographic Institution, Mass.). May 1969. Contract AT(30-1)-2174. 28p. Dep. CFSTI.

The major variations in trace element concentrations, as determined by activation analysis or spectrometry, are related to the degree of deposition of ferromanganic oxides on the coral surface. Deep open-ocean corals show the highest degree of staining and the highest concentration of such elements as Ba, Co, Ni, Y, Cu, Fe, Mn, Pb, Sc, and La. However, fresh, unstained corals from the deep sea show no marked differences from those of other environments. The environmental factor seems to be more significant in controlling the coral U concentration than a species-specific affect. It would appear feasible to distinguish reef specimens from near-reef specimens on the basis of the latter's higher U concentration. Sensitivity limits for determination of Ca, Ce, Co, Cr, Eu, Fe, La, Sc, U, and Zn are given. (auth)

49751 MINERAL ORE EXPLORATION APPARATUS UTILIZING NEUTRON ACTIVATION. Senftle, Frank E.; Hoyte, Alfred F.; Martinez, Prudencio Jr. (to Secretary of the Interior). U. S. Patent 3,463,922. Filed July 29, 1966.

The design of an apparatus is given for the analysis of the mineral ore content in a ground area. Adjustable mechanisms operate the apparatus for a neutron generating source to irradiate the zone for a limited time, and thereafter release a detector to take a position over the zone to measure gamma rays emitted by the substances due to neutron absorption. (Offic. Gaz.)

49752 ^{65}Zn, NICKEL, COPPER, AND ZINC CONTENTS OF THE BOGOU IRON METEORITE. Heydegger, H. R.; Turkevich, Anthony (Univ. of Chicago). J. Geophys. Res., 74: 4949-57 (Sept. 15, 1969).

The ^{65}Zn content of a portion of the Bogou iron meteorite, which fell in Upper Volta on August 14, 1962, has been determined by means of radiochemical techniques. The specific activity of ^{65}Zn in Bogou at the time of fall was estimated to be 5.0 ± 1.7 dpm kg^{-1}. It is suggested that this nuclide may have been produced principally by the $^{62}Ni(\alpha,n)^{65}Zn$ reaction induced by solar flare particles. The elemental abundances of Cu and of Zn in the same portion of the Bogou meteorite have been determined by neutron activation analysis to be 154 ± 8 ppm and 67 ± 3 ppm, respectively. The Ni abundance was determined gravimetrically to be 7.0 ± 0.4%. (auth)

49753 OXYGEN CONTENT OF GALLIUM PHOSPHIDE, SILICON, AND GERMANIUM BY ^{3}He ACTIVATION. Kim, Chong K. (Bell Telephone Labs., Inc., Murray Hill, N. J.). Radiochem. Radioanal. Lett., 2: 53-60(Oct. 13, 1969).

Oxygen content of gallium phosphide, silicon, and germanium single crystals was experimentally measured by ^{3}He doubly charged ion bombardment inducing $^{16}O(^{3}He,p)^{18}F$ reaction, and coincidence counting of ^{18}F annihilation radiation following radiochemical separation. The results are in good agreement with theoretical estimation, and also supported indirectly by silicon data obtained by this technique and infrared absorption analysis. The precision of the analysis is better than ±20%. (auth)

49754 APPLICATIONS OF NEUTRON ACTIVATION ANALYSIS TO THE MEASUREMENT OF THE EVAPORATION RATE OF SOLIDS IN THE RANGE OF 10^{-7} TO 10^{-9} g cm^{-2} sec^{-1}. Maslov, I. A.; Lukhnitskii, V. A.; Karnaukhova, N. M.; Karaganova, G. I. (Ioffe Inst. of Physics and Tech., Leningrad). Nucl. Appl. Technol., 7: 389-92(Oct. 1969).

To measure the evaporation rate of solids in vacuum, the evaporating substance was condensed on a water-cooled lead plate. The plate with the condensate was removed, irradiated by neutrons, and etched in a mixture of nitric and hydrofluoric acids, and the radioactive isotopes in the solution were identified. The possibilities of the method are illustrated by measurement of molybdenum metal and zirconium carbide evaporation rates. The amount of molybdenum (^{99}Mo) was determined by direct γ spectrometry of the solution. In the case of zirconium, radiochemical isolation of ^{95}Zr from the mixture of antimony, zinc, tantalum, and hafnium present in the solution in amounts commensurable with that of zirconium was suggested. The vaporization experiment was carried out in a vacuum about 10^{-5} to 10^{-6} torr. The measured values of the molybdenum and zirconium carbide evaporation rates in the temperature range about 1900 to 2400°C are given. (auth)

49755 DETERMINATION OF ^{16}O IN MICROCRYSTALLINE CARBON BY INDIRECT NEUTRON ACTIVATION ANALYSIS. Mattson, James S.; Crittenden, John C.; Mark, Harry B, Jr. (Univ. of Michigan, Ann Arbor). Nucl. Appl. Technol., 7: 383-4(Oct. 1969).

A method for determination of oxygen in carbon and organic materials employing the $^{16}O(^{3}T,n)^{18}F$ reaction is described. The technique is applicable for amounts of ^{16}O as low as 0.1 mg, and the application of the method to the determination of the oxygen content in activated carbon is reported. (auth)

49756 CHARACTERISTICS OF AN "ON-STREAM" ANALYSIS SYSTEM USING A MULTIKILOCURIE ^{124}Sb–Be NEUTRON SOURCE. Downs, W. E.; Davis, M. W. (Atomic Energy of Canada Ltd., Ottawa). Nucl. Appl. Technol., 7: 466-71(Nov. 1969).

Parameters of a ^{124}Sb–Be neutron source used for "on-stream" elemental analysis are described. An analytical study of a basic "on-stream" system is given and some preliminary experimental results are compared with the calculations. The system consists of an irradiation chamber containing the ^{124}Sb–Be source and a counting chamber with a delay line connecting the two. The unit can handle up to 7,200 curies of ^{124}Sb, which gives a thermal neutron flux of approximately 2×10^8 n/(cm^2-sec) on the inside surface of the cylindrical irradiation chamber. A 13-liter irradiation chamber was found to be an optimum volume for all but very short-lived isotopes. In separate solutions, the elements Al, Hf, In, Mn, Ag, and V can be determined repetitively in 5 to 10 minute cycles at <100 ppm using a 2.7 liter counting chamber. Calculated sensitivities for a number of elements and actual measured values for Al, Cl, Co, Hf, Mg, Na, and Cu are given. (auth)

49757 NEUTRON ACTIVATION ANALYSIS OF THE SELENIUM CONTENT OF FOSSIL FUELS. Pillay, K. K. S.; Thomas, C. C. Jr.; Kaminski, J. W. (Western New York Nuclear Research Center, Inc., Buffalo). Nucl. Appl. Technol., 7: 478-83 (Nov. 1969).

The selenium contents of over 120 fossil fuel samples from various areas in the United States were determined using neutron activation analysis combined with extractive distillation of selenium. The Se/S ratio in these fuel samples was also calculated to determine the constancy of this ratio in fossil fuels. Possible applications of Se/S ratio measurements in air pollution studies are discussed. (auth)

49758 DOSE CONTROL OF SUPPOSITORIES BY NEUTRON-ACTIVATION ANALYSIS. Holm, V.; Steinnes, E.; Waaler, T. (Univ., Oslo). Medd. Norsk Farm. Selsk., 30: No. 2, 17-33 (1968).

Determinations based on induced ^{82}Br activity were made on model suppositories of atropine methobromide contained in sealed polyethylene tubes, which were packed in layers (7 in each) in aluminum containers; two polyethylene tubes, containing a standard solution of hyoscine hydrobromide, were placed diametrically in each layer. The containers were irradiated for 1 hr in a neutron flux of 2.5×10^{12} neutrons per sq cm per sec. After 24 hr, the polyethylene tubes containing the suppositories were heated at 50°C for ≈30 min and then cooled to room temperature, and scintillation counts were made. Frequency diagrams for two series of 100 samples showed variations from the mean within ±8% for most of the samples. (Anal. Abstr.)

49759 DETERMINATION OF SELENIUM IN BIOLOGICAL MATERIALS BY NEUTRON ACTIVATION ANALYSIS USING 8-MERCAPTOQUINOLINE. Veveris, O. E.; Mikhel'son, G. G.; Pelekis, Z. E.; Pelekis, L. L.; Taure, I. Ya. (Inst. of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser., No. 2, 25-8(1969). (In Russian).

Chemical separation of selenium followed by neutron activation analysis were used for the determination of selenium in biological materials. Selenium-77m, with a half-life of 17.5 sec was used in the neutron activation and 8-mercaptoquinoline concentration and separation of selenium. (tr-auth)

49760 RADIO-RELEASE DETERMINATION OF FLUORIDE ION. Carmichael, I. A.; Whitley, J. E. (Scottish Research Reactor Centre, East Kilbride, Scotland). Analyst, 94: 737-9 (Sept. 1969).

A radiorelease method was developed for the determination of fluoride, which is applicable to amounts of 20 μg or above, 100 μg being the upper limit investigated. The standard deviation, found from trial determinations over this range, averages ±5 per cent. Phosphate, iron, and aluminum interfere. The method involves reactions between fluoride and irradiated zirconium selenite, and counting ^{75}Se to determine a normalizing factor. (auth) (UK)

49761 DETERMINATION OF INORGANIC IODIDE IN URINE BY NEUTRON-ACTIVATION ANALYSIS. Morgan, D. J.; Black, A.; Mitchell, G. R. (Atomic Energy Research Establishment, Harwell, Eng.). Analyst, 94: 740-3(Sept. 1969).

The determination of stable inorganic iodide in body fluids by neutron activation is a well documented technique. Normally, however, it involves either a chemical separation or a preferential elution step. A preliminary investigation of the latter method showed that by using ammonium nitrate as the eluent a considerably sharper separation of the iodine-128 can be obtained. (auth) (UK)

49762 RAPID NONDESTRUCTIVE METHOD FOR DETERMINATION OF HAFNIUM IN ZIRCONIUM DIOXIDE AND TAIWAN ZIRCON BY NEUTRON ACTIVATION. Wu, Shaw-chii; Chern, Sheng-laang (Inst. of Nuclear Energy Research, [Taiwan]). Ho Tsu K'o Hsueh, 6: No. 3-4, 97-101(Apr. 1969).

A nondestructive method was used for the determination of hafnium in zirconium dioxide and Taiwan Zircon by neutron activation. The gamma spectra of tantalum-181 m_1, daughter of hafnium-181, were measured by a 2 × 2 in. NaI(Tl) scintillator and a 100-channel pulse height analyzer, and the 0.480 MeV characteristic peak was chosen for quantitative determination. (auth)

49763 INVESTIGATION OF TRACE QUANTITIES OF ATOMS OF CERTAIN HEAVY METALS IN DNA AND RNA BY THE METHOD OF ACTIVATION ANALYSIS. Belokobyl'skii, A. I.; Ginturi, E. N.; Mosulishvili, L. M.; Kharabadze, N. E. (Inst. of Physics, Tbilisi, USSR). Biophysics (USSR) (Engl. Transl.), 13: 1112-17(1968).

Translated from Biofizika, 13: 950-4(1968).

A highly sensitive method for the quantitative determination of zinc, manganese, copper, and gold in milligram amounts in nuclear acids is described. The quantitative contents of the trace elements zinc, manganese, copper, and gold have been determined for rabbit pancreas DNA and RNA. Indirect evidence was obtained (using dialysis) on the firmness of the linkage of metal atoms with the DNA molecules. (auth)

49764 MANGANESE DETERMINATION IN MAMMALIAN BONE BY NEUTRON ACTIVATION ANALYSIS. Howes, A. D.; Haller, W. A.; Dyer, I. A. (Washington State Univ., Pullman). Life Sci., 8: 583-9(June 15, 1969).

A specially prepared hydrated antimony pentoxide resin (HAP) that can remove radiosodium from strong acid solutions facilitated development of a fast and simple determination of low concentrations of Mn in mammalian bone. Sensitivity in determining Mn can be increased by using neutron activation analysis, but it is essential to eliminate γ ray sources that mask the photopeak of ^{56}Mn. Results showed that Mn concentrations in bone can vary among mammalian species (rat, 0.35, rabbit, 2.12, and calf, 1.26 μg/g of bone). (D.H.M.) (TSS)

49765 SOME APPLICATIONS OF NON-DESTRUCTIVE ACTIVATION ANALYSIS. Meyers, Pieter. Amsterdam, University of Amsterdam, 1968. 83p.

Thesis.

Several nondestructive methods of activation analysis based on the comparator method are considered. Topics covered include: irradiation facilities and measuring equipment, charged particle activation analysis of ancient gold and silver coins, fast neutron activation analysis of objects with copper as the main component, and high-energy photon activation analysis of iron meteorites and fossil bones. (M.C.G.)

Inorganic, Organic, and Physical Chemistry

Refer also to abstracts 49754, 49936, 50061, 50149, 50979, 51134, and 52343.

49766 (BNWL-1051(Pt.2), pp 157-8) RATE CONSTANTS OF ORGANIC COMPOUNDS WITH HYDROXYL RADICALS. Kalkwarf, D. R. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Triphenylmethane dyes were reacted with ethanol and sodium benzonate separately during irradiation of aerated aqueous solutions. Destruction of dye was measured photometrically, and dye absorbance was found to decrease exponentially with absorbed dose in each case. Data are tabulated. These studies were made in attempts to understand the course of damage in irradiated biochemical systems. Data on bimolecular rate constants for reactions of biochemicals with hydroxyl radicals are also tabulated. (P.C.H.)

49767 (CEA-R-3476) CONTRIBUTION TO THE SOLUTION CHEMISTRY OF URANIUM(VI). Taymbal, Claude (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). 1969. 99p. (In French). Dep. CFSTI (U. S. Sales Only).

Thesis. Submitted to Univ., Grenoble, France.

A potentiometric study of the complexes formed by the uranyl ion with the hydroxy ligand was performed. Evidence is presented for the existence of the following complexes with their respective stability constants (determined at 25°C in 0.1 M $NaClO_4$ medium): UO_2OH $\log\beta_{1,-1} = -4.39$; $(UO_2)_2OH$, $\log\beta_{2,-1} = -2.22$; $(UO_2)_2(OH)_2$, $\log\beta_{2,-2} = -6.09$; $(UO_2)_3(OH)_5$, $\log\beta_{3,-5} = -15.64$; $(UO_2)_3(OH)_7$, $\log\beta_{3,-7} = -24.03$. A similar investigation was undertaken on

the complexes formed by the uranyl ion with carbonate and/or hydroxyl ligands; the latter appearing in neutral or acid media. Evidence is presented for the existence of the following complexes and their respective stability constants, all determined at 25°C in 0.1 M $NaClO_4$ medium: $UO_2(CO_3)_3$, $\log\beta_{3,1,0} = 21.57$; $UO_2(CO_3)_2$, $\log\beta_{2,1,0} = 16.16$; UO_2CO_3OH, $\log\beta_{1,1,-1} = 4.10$. The solid phases of the system $UO_2(NO_3)_2 - NaOH - H_2O$ were investigated by the method of residues. In this system the following compounds were identified: $U_2O_7Na_2$ and $(NO_3)_2\ U_6O_{17}$ in slightly acid medium. The solid phases of the system $UO_2(NO_3)_2 - Na_2CO_3 - H_2O$ were investigated. The following compounds were identified: UO_2CO_3, in slightly acid medium and uranyl alkaline carbonate appearing in neutral medium with the formula $(UO_2CO_3)_3\ (NaOH)_2$, as well as the corresponding uranates. (auth)

49768 (ORNL-TM-2065(Pt.1)) THE STABILITY OF URANIUM TRIFLUORIDE. PART I. STABILITY IN THE SOLID PHASE. Long, G.; Blankenship, F. F. (Oak Ridge National Lab., Tenn.). Nov. 1969. Contract W-7405-eng-26. 28p. Dep. CFSTI.

The equilibrium pressures of HF produced in the reaction $UF_{4(c)} + \frac{1}{2}H_{2(g)} \rightleftharpoons HF_{(g)} + UF_{3(ss)}$ (with UF_3 in solid solution with UF_4) were measured over the temperature range 565 to 889°C. From the data, with corrections for the formation of the solid solution, the difference in free energies of formation of UF_3 and UF_4 and the thermochemical properties of UF_3 were derived. From measurements made above the melting point of the UF_3–UF_4 eutectic (892°C) deductions were made regarding the UF_3–UF_4 phase diagram. (auth)

49769 (ORNL-TM-2667) THE SOLUBILITY OF Fe_3O_4 IN DILUTE ACID AND BASE SOLUTIONS TO 300°C. Sweeton, F. H.; Baes, C. F. Jr.; Jenks, G. H. (Oak Ridge National Lab., Tenn.). July 31, 1969. 19p. (CONF-690609-24). Dep. CFSTI.

From 15th Annual Meeting of the American Nuclear Society, Seattle, Wash.

The solubility was measured by pumping solutions, which varied in composition between 10^{-1} m HCl and 4×10^{-4} m KOH, and which were presaturated at 25°C with H_2 at 1 atm, through a heated column containing Fe_3O_4 in a pressurized system. The dissolved Fe in the effluent solution was collected on an ion exchanger for later chemical determination. The solubilities, measured at temperatures between 50 and 300°C, were fit with a scheme involving the species Fe^{2+}, $FeOH^+$, $Fe(OH)_2$, and $Fe(OH)_3^-$ by the reaction $\frac{1}{3}Fe_3O_4 + (2 - b)H^+ + \frac{1}{3}H_2(g) = Fe(OH)_b^{(2-b)+} + (\frac{1}{3} - b)H_2O$. In acid and neutral solutions the overall solubility was found to vary inversely with temperature and alkalinity, but in the more alkaline solutions at high temperatures, the solubility varied in the opposite directions. The solubility data indicate that Fe_3O_4 columns used for purification in pressurized-water systems should be placed in the high temperature zone if the solution is neutral, and in the low temperature zone if the solution is alkaline. Observed behavior of cruds in loops and reactor systems were compared with the observed solubility of Fe_3O_4. Local boiling in reactor cores is shown to be a possible mechanism for local deposition. (auth)

49770 (UCRL-18667, pp 247-54) PHOTOELECTRON SPECTROSCOPY. (California Univ., Berkeley. Lawrence Radiation Lab.).

NITROGEN — compounds, spectra of, measurement of chemical shifts in inner-electron binding energies from x-ray photoelectron
ORGANIC COMPOUNDS, NITRO- — spectra of, measurement of chemical shifts in inner-electron binding energies from x-ray photoelectron
ORGANIC COMPOUNDS, PHOSPHO- — spectra of, measurement of chemical shifts in inner-electron binding energies from x-ray photoelectron
PHOSPHORUS — compounds, spectra of, measurement of chemical shifts in inner-electron binding energies from x-ray photoelectron
PLUTONIUM — spectra of inner atomic levels in, x-ray photoelectron
THORIUM — spectra of inner atomic levels in, x-ray photoelectron
TRANSITION METALS — spectra of core and valence electron levels in, x-ray photoelectron
URANIUM — spectra of inner atomic levels in, x-ray photoelectron (P.C.H.)

49771 (UCRL-18667, pp 255-76) X-RAY CRYSTALLOGRAPHY. (California Univ., Berkeley. Lawrence Radiation Lab.).

ALUMINUM CHLORORUTHENATES — structure of hexaaquoaluminum hexachlororuthenate tetrahydrate, crystal and molecular
ARSENIC FLUORIDES — $AsF_5 - XeF_2$, crystal structure of compound formed in
BORON FLUORIDES — reactions with phosphorus trifluoride, crystal and molecular structure of $B_4F_6PF_3$ produced by condensation
COBALT, TETRAMETHYLAMMONIUM BIS(TRIBROMODICARBONONABORYL)- — crystal structure of $N(CH_3)_4(CB_9C_2H_8Br_3)_2Co$
EINSTEINIUM CHLORIDES — crystal structure and lattice parameters of
EINSTEINIUM OXYCHLORIDES — crystal structure and lattice parameters of
LEAD HYDROXIDE PERCHLORATES — crystal structure of $Pb_6O(OH)_6(ClO_4)_4 \cdot H_2O$
NICKEL BROMIDES — complexes with quinoline and tetrabutylammonium bromide, structure of, crystal and molecular
NICKEL CHLORIDES — complexes with benzimidazole in acetone, crystal structure of
NICKEL IODIDES — complexes with tetraphenylarsonium iodide and triphenylphosphine, structure of, crystal and molecular
PLATINUM, HYDROXYTRIMETHYL- — crystal structure of (P.C.H.)

49772 (UCRL-18667, pp 277-312) PHYSICAL AND INORGANIC CHEMISTRY. (California Univ., Berkeley. Lawrence Radiation Lab.).

CESIUM BERKELIUM CHLORIDES — crystal structure of Cs_2BkCl_6
CESIUM PLUTONIUM CHLORIDES — crystal structure of Cs_2PuCl_6
CESIUM SODIUM BERKELIUM CHLORIDES — crystal structure of $Cs_2NaBkCl_6$
ELEMENT ONE HUNDRED AND TEN — search for, and isotope-294, in nature
ELEMENT ONE HUNDRED AND FOURTEEN — production of isotope-284 of, cross sections for
HYDROBROMIC ACID — separation by solvent extraction using trioctylphosphine oxide in 1,2-dichloroethane and nitrobenzene
HYDROCHLORIC ACID — separation by solvent extraction using trioctylphosphine oxide in 1,2-dichloroethane and nitrobenzene
MENDELEVIUM — separation from sodium acetate solutions by solvent extraction using sodium amalgam
— separation from einsteinium and fermium by electrolysis
— stability of divalent state of
NOBELIUM — oxidation potential of divalent–trivalent couple of
PERRHENIC ACID — separation by solvent extraction using trioctylphosphine oxide in 1,2-dichloroethane and nitrobenzene
URANIUM — spectra in calcium fluoride, effects of uranium oxidation states on (P.C.H.)

49773 QUENCHING OF FLUORESCENCE OF URANYL IONS BY ORGANIC SUBSTRATES. Venkatarao, K.; Santappa, M. (Univ. of Madras). Z. Phys. Chem. (Frankfurt), 66: 308-16(Aug. 1969).

The quenching of uranyl ion fluorescence by formaldehyde, acetaldehyde, methanol, and isopropanol in aqueous perchloric acid solutions was studied at three monochromatic wavelengths, 365 mμ, 405 mμ, 436 mμ. Stern–Volmer plots were drawn and the rate parameters were calculated and compared with those obtained from kinetics of photochemical oxidation of these substrates by uranyl ions. The mechanism of photochemical oxidation of substrates by uranyl ions is discussed in the light of the experimental results. (auth)

49774 APPLICATION OF SECONDARY α-DEUTERIUM KINETIC ISOTOPE EFFECTS TO STUDIES OF ENZYME CATALYSIS. GLYCOSIDE HYDROLYSIS BY LYSOZYME AND β-GLUCOSIDASE. Dahlquist, F. W.; Rand-Meir, T.; Raftery, M. A. (California Inst. of Tech., Pasadena). Biochemistry, 8: 4214-21 (Oct. 1969).

Secondary kinetic isotope effects (α-deuterium) were explored as a method for delineating the nature of the transition state in enzyme-catalyzed reactions. Hen egg-white lysozyme and almond β-glucosidase were chosen as enzymes for these experiments. Initially, model studies were performed on the cleavage of phenyl glucosidic bonds in acid (SN1 mechanism) and in base (SN2 mechanism). The values obtained ($k_H/k_D = 1.13$ for SN1 mechanism, $k_H/k_D = 1.03$ for SN2 mechanism) were in the anticipated range. The value obtained for β-glucosidase-catalyzed hydrolysis of phenyl β-D-glucopyranoside was $k_H/k_D = 1.01$, and this suggests a displacement mechanism for this enzyme. Such a result is in agreement with recent chemical evidence. For application of the method to studies of the lysozyme mechanism, the disaccharide

phenyl 4-O-(2-acetamido-2-deoxy-β-D-glucopyranosyl)-β-D-glucopyranoside was synthesized by enzymatic transglycosylation using ^{3}H- and ^{14}C-labeled phenyl glucosides (C_1-H and C_1-d, respectively). The value of k_H/k_D obtained for the lysozyme-catalyzed hydrolysis of this aryl disaccharide glycoside was determined to be 1.11. This result indicated considerable carbonium ion character in the transition state of the enzyme-catalyzed reaction. It was found that this result held over the pH range 3.1 to 8.3 as well as close to the pH optimum. (auth)

49775 EFFECT OF TERTIARY ALIPHATIC AMINES ON THE HETEROGENEOUS ISOTOPIC EXCHANGE IN THE Zn–AMALGAM–$Zn^{++}(SO_4^{--})$-SOLUTION SYSTEM. Filip, A.; Mirnik, M. (Boris Kidric Inst. of Nuclear Sciences, Belgrade. Univ. of Zagreb). Z. Phys. Chem. (Frankfurt), 66: 269-78(Aug. 1969).

The effect of some tertiary aliphatic amines on the reaction rate and on the mechanism of the amalgam isotope exchange was investigated in the system Zn amalgam – Zn^{2+} (SO_4^{2-}) solution with $c_{zn}^{2+} = 5.10^{-2}$ gramatom/liter and $c_m^{2+} = 1.10^{-2}$ gramion/liter. The increase of the number of C atoms in the carbon chain of the amines induces a decrease of the exchange rate for equal amine concentrations. In all plots for logarithm exchange rate vs. logarithm amine concentration the curves show an inflection for each amine at a different concentration. The agreement between the experimental adsorption isotherms and Langmuir's adsorption isotherm for thiethylamine, tripropylamine and tri-n-butylamine and Frumkin's adsorption isotherm for tri-n-heptylamine and tri-n-octylamine is satisfactory. The increase in the acidity of the solution causes a decrease of the exchange rate. (auth)

49776 PREDICTIONS OF ISOTOPE EFFECTS IN S_N2 REACTIONS. Willi, A. V. (Columbia Univ., New York). Z. Phys. Chem. (Frankfurt), 66: 317-28(Aug. 1969).

A simple semiempirical model is suggested for description of the energy barrier in S_N2 transition states. The model is based on an adaption of the Johnston equation. It supplies a basis for the evaluation of the force constants F_{11}, F_{22}, and F_{12} of the transition state, whose values must be known for complete predictions of kinetic isotope effects. The constants of the model for a particular reaction may be derived from experimental $\Delta G^{\ddagger}$ and ΔG values. The influence of the nucleophilic powers of entering and leaving groups on the constants of the energy barrier is discussed. It is suggested that a new evaluation of the problem of nucleophilic reactivity be carried out on a wider basis, with consideration of rate data, as well as of equilibrium data. (auth)

49777 TERNARY OXIDES OF PENTA- AND HEXAVALENT NEPTUNIUM WITH RARE EARTHS. Keller, C.; Engerer, H.; Seiffert, H. (Univ., Karlsruhe, Ger. Kernforschungszentrum, Karlsruhe, Ger.). J. Inorg. Nucl. Chem., 31: 2727-32(Sept. 1969). (In German).

Ternary oxides of pentavalent and hexavalent neptunium with rare earths of the formula types $(Np_{0.5}, RE_{0.5})O_2$ and NpO_3 $6REO_{1.5}$ were obtained by solid-state reactions at $p(O_2) = 1$ atm. The double oxides with Np(V) prepared at 1100°C correspond to an ideal fluorite lattice with the composition $(Np_{0.5}, RE_{0.5})O_{2.00}$. The compounds $NpO_3 \cdot 6REO_{1.5}$ are characterized by a rhombohedral structure and are isostructural with the corresponding 1:6 uranium compounds (space group $R\bar{3}$). The neptunium analogues, however, possess no phase range. There exist linear dependencies of the lattice constants of the double oxides $(Np_{0.5}, Re_{0.5})O_2$ and of the mole volumes ($\sqrt[3]{V_{Mole}}$) of the compounds $NpO_3 \cdot 6REO_{1.5}$ on the RE^{3+} ionic radii. The compound NpO_3 $6HoO_{1.5}$, which was studied in more detail, was obtained at from 1100°C to 1700°C at $p(O_2) = 1$ atm. A release of oxygen was observed only at about 1400°C. No neptunyl absorption bands were detected in the ir spectrum of $NpO_3 \cdot 6HoO_{1.5}$. (auth) (UK)

49778 CRYSTAL STRUCTURE OF THE COMPOUNDS U_2N_2X AND $Th_2(N,O)_2X$, WITH X = P, S, As, AND Se. Benz, Robert (Los Alamos Scientific Lab., N. Mex.); Zachariasen, W. H. Acta Crystallogr., Sect. B, 25: 294-6(1969).

The compounds Th_2NOAs, Th_2NOP, Th_2N_2S, Th_2N_2Se, U_2N_2As, U_2N_2P, U_2N_2S, and U_2N_2Se were prepared. From x-ray-diffraction powder patterns, the compounds were found to have the Ce_2O_2S-type crystal structure (space group $P\bar{3}m1$). Lattice parameters are given. With the origin chosen at the X atom, where X = P, As, S, or Se, the two metal atom (either Th or U) positions are $\pm(\frac{1}{3},\frac{2}{3},u_1)$ where $u_1 = 0.293 \pm 0.005$ for X = As or Se and $u_1 = 0.278 \pm 0.005$ for X = P or S. The probable locations of the two nitrogen (or nitrogen + oxygen) atoms are $\pm(\frac{1}{3},\frac{2}{3},u_2)$ with $u_2 \simeq 0.63$. Apparent anomalous interatomic distances between the metal and different nonmetal atoms occur and these are attributed to different bond strengths. (auth)

49779 FAR-INFRARED SPECTRA OF RING COMPOUNDS. IV. SPECTRA OF COMPOUNDS WITH AN UNSYMMETRICAL POTENTIAL FUNCTION FOR RING INVERSION. Carreira, L. A.; Lord, R. C. (Massachusetts Inst. of Tech., Cambridge). J. Chem. Phys., 51: 2735-44(Sept. 15, 1969).

The infrared spectra of gaseous trimethylenimine, trimethylenimine-N-d, 2,5-dihydropyrrole, 2,5-dihydropyrrole-N-d, and cyclopentene oxide were observed in the range 300 to 25 cm^{-1}. The N–H bonds of trimethylenimine and 2,5-dihydropyrrole and the oxygen atom of cyclopentene oxide introduce asymmetry into the potential function for inversion of the ring in these molecules. In consequence the eigenvalues of the inversion vibrations are quite irregular but can be inferred from the spectra and fitted to a potential function of the form $V(x) = ax^4 - bx^2 + cx^3$, where x is the ring-inversion coordinate. Interpretation of the far-infrared spectrum also enables assignment of the satellite fine structure of certain of the mid-infrared fundamentals as difference bands involving the inversion vibration. (auth)

49780 STRUCTURE OF THE ALKALI HYDROXIDES. V. THE INFRARED SPECTRA OF MATRIX-ISOLATED RbOH, RbOD, NaOH, AND NaOD. Acquista, N.; Abramowitz, S. (National Bureau of Standards, Washington, D. C.). J. Chem. Phys., 51: 2911-14(Oct. 1, 1969).

The infrared spectra of matrix-isolated RbOH, RbOD, NaOH, and NaOD were observed. Both the alkali metal–oxygen stretch ν_1 and the bending mode ν_2 were assigned for each species. The metal–oxygen stretching mode is found at 354.4, 345, 431, and 422 cm^{-1} for RbOH, RbOD, NaOH, and NaOD, respectively; the bending mode ν_2 is observed at 309.0, 229, 337, and 250 cm^{-1}, respectively. Combination of the results of the study with the microwave measurements for RbOH and RbOD indicates an essentially linear structure for these species. The isotope shift for ν_2 observed in NaOH coupled with reasonable bond lengths indicates an equilibrium configuration of NaOH which probably does not deviate significantly from linearity. The assumption of a linear model with a harmonic bending potential yields force constants of 0.046×10^{-18} and 0.053×10^{-18} Nm (0.046 and 0.053 mdyn · Å) for RbOH and NaOH, respectively. These results are consistent with previously reported results for CsOH. (auth)

49781 HEAT CAPACITY OF LUTETIUM FROM 6 TO 300°K. Gerstein, B. C.; Taylor, W. A.; Shickell, W. D.; Spedding, F. H. (Ames Lab., Iowa). J. Chem. Phys., 51: 2924-8(Oct. 1, 1969).

The heat capacity of lutetium was measured from 6 to 300°K. The results differ from a previous measurement in this temperature range by more than the accuracies of the measurements. The difference is discussed in terms of impurity effects. The thermodynamic functions are tabulated for the temperature range studied. (auth)

49782 NEW COMPLEXES OF RUTHENIUM(II) WITH TRIPHENYLPHOSPHINE AND OTHER LIGANDS. Gilbert, J. D.; Wilkinson, G. (Imperial Coll. of Science and Tech., London). J. Chem. Soc., A, No. 12, 1749-53(1969).

The interactions of dichlorotris(triphenylphosphine)ruthenium(II), $RuCl_2(PPh_3)$, with various reagents was studied and the resulting complexes characterised by ir and NMR spectroscopy. The new complexes comprise those of nitriles, $RuCl_2(RCN)_2(PPh_3)_2$; amines, $RuCl_2(amine)_2(PPh_3)_2$; β-diketonates, $Ru(\beta\text{-diket})_2(PPh_3)_2$; carboxylates, $Ru(OCOR)_2(PPh_3)_2$; the halogen bridged dimer $[RuCl_2(PPh_3)_2]_2$ and its acetone solvate; and chloro-π-cyclopentadienylbis(triphenylphosphine)ruthenium(II). (auth) (UK)

49783 A STUDY OF THE ISOTOPIC EXCHANGE BETWEEN METHYLENE IODIDE AND POTASSIUM IODIDE. Pataki, L.; Beronius, P.; Kocsis, S. E. (Lorand Eoetvoes Univ., Budapest). Radiochem. Radioanal. Lett., 2: 101-6(Oct. 13, 1969).

The isotopic exchange reaction of methylene iodide and potassium iodide was investigated in an ethanolic medium at different temperatures. The kinetic and activation parameters were determined. It was concluded that the exchange rate decreases with an increasing number of iodine atoms in the molecules of iodine methane derivatives, which can be interpreted by the increase in the covalent character of the C–I bond. (auth)

49784 INFRARED SPECTRA AND STRUCTURE OF HYDRATES OF URANIUM PEROXIDE $UO_4 \cdot xH_2O$. Novitskii, G. G.; Umreiko, D. S.; Shamanovskaya, R. I. Zh. Neorg. Khim., 14: 2313-15(Sept. 1969). (In Russian).

The products from the reaction of anhydrous hydrogen peroxide and uranyl nitrate dihydrate and hexahydrate in 0.1 and 0.2 mole ether solutions were studied by elementary and spectral methods. Conclusions were drawn on the structure of complex compounds of the type $UO_4 \cdot nH_2O$. (tr-auth)

49785 REACTIONS OF THE RARE EARTH CHLORIDES WITH AMMONIUM CARBONATE. Tselik, I. N.; Deineka, F. G.; Fedorenko, V. D.; Shvartsman, V. Ya. Zh. Neorg. Khim., 14: 2356-61(Sept. 1969). (In Russian).

The reactions of the chlorides of lanthanum, neodymium, gadolinium, dysprosium, yttrium, and erbium with ammonium carbonate in aqueous solutions at 25°C were studied. It was established that in dilute solutions the reactions in the $LnCl_3-(NH_4)_2CO_3-H_2O$ system proceed in several stages. Initially in all systems when the ratio of $CO_3^{2-}:Ln^{3+} \leq 2$ the reaction proceeds with the formation of normal carbonates, but when $n > 2$, double carbonates of variable composition are formed for which the solubility in excess ammonium carbonate increases in the series La–Nd–Cd–Dy–Y–Er. The reactions of the rare earth chlorides, with the exception of La, with ammonium carbonate in concentrated solutions proceed with the formation of double carbonates. (tr-auth)

49786 OXALATONITRATE COMPOUNDS OF URANYL. Kuzina, M. G.; Lipovskii, A. A. Zh. Neorg. Khim., 14: 2461-5(Sept. 1969). (In Russian).

The formation of different complex compounds of uranyl ions in which the coordination sphere of the uranium atom contains oxalate and nitrate groups was investigated by means of electron absorption spectra, infrared absorption spectra, and analysis of organic solutions. Variants of the structure of the oxalatonitrate complex compounds are discussed. (tr-auth)

49787 CONCERNING REACTIONS OF SODIUM AQUODIOXALATOURANYLATE WITH UREA. Shchelokov, R. N.; Belomestnykh, V. I. Zh. Neorg. Khim., 14: 2466-8(Sept. 1969). (In Russian).

It was shown that $Na_2[UO_2(C_2O_4)H_2O]\cdot 4H_2O$, in contrast to other derivatives of aquodioxalatouranylate ion, with urea forms not only $Na_2[UO_2(C_2O_4)_2\{CO(NH_2)_2\}]\cdot 3H_2O$ but also complexes which contain urea in the external sphere $[Na_2\{CO(NH_2)_2\}]\cdot[UO_2(C_2O_4)_2-\{CO(NH_2)_2\}]\cdot 3H_2O$. Some physical and chemical properties of the compounds are described. (tr-auth)

49788 THE SOLUBILITY OF α–ZIRCONIUM PHOSPHATE AND HAFNIUM PHOSPHATE IN STRONG PHOSPHORIC ACID. Clearfield, A.; Thomas, J. R. (Ohio Univ., Athens). Inorg. Nucl. Chem. Lett., 5: 775-9(Sept. 1969).

Addition of phosphate ion to solutions of Zr(IV) salts produces gelatinous precipitates of variable composition commonly called zirconium phosphate. These gels are converted to a stoichiometric crystalline phase, zirconium bis(monohydrogen orthophosphate) monohydrate, $Zr(HPO_4)_2\cdot H_2O$, called α–ZrP, by refluxing in strong phosphoric acid. A preliminary study of the conditions under which crystallization occurs revealed that the rate of conversion of gel to crystals is roughly proportional to the concentration of phosphoric acid and the temperature. These results suggest that crystallization occurs by a "digestion" mechanism in which constant solution and reprecipitation take place. Therefore, it was of interest to determine the solubility of zirconium phosphate in strong phosphoric acid solutions. The solubility of hafnium phosphate was determined similarly. (auth) (UK)

49789 MOLECULAR g VALUES, MAGNETIC SUSCEPTIBILITIES, MOLECULAR QUADRUPOLE MOMENTS, AND SIGN OF THE ELECTRIC DIPOLE MOMENT IN CYCLOPROPENE. Benson, R. C.; Flygare, W. H. (Univ. of Illinois, Urbana). J. Chem. Phys., 51: 3087-96(Oct. 1, 1969).

The high-field rotational Zeeman effect was studied in cyclopropene and 1,2-dideuterocyclopropene. The molecular g values for cyclopropene are $g_{aa} = -0.0897 \pm 0.0009$, $g_{bb} = -0.1491_5 \pm 0.0001_6$, and $g_{cc} = 0.0536_3 \pm 0.0001_7$. For the deuterated species they are $g_{aa} = -0.0689 \pm 0.0010$, $g_{bb} = -0.1371_8 \pm 0.0001_5$, and $g_{cc} = 0.0453_8 \pm 0.0001_8$. The magnetic susceptibility anisotropies, in units of 10^{-6} erg/G^2·mole, are $2\chi_{aa} - \chi_{bb} - \chi_{cc} = 7.1 \pm 0.6$ and $-\chi_{aa} + 2\chi_{bb} - \chi_{cc} = 26.8 \pm 0.4$. Although only the relative signs of the g values are determined experimentally, the above signs are conclusively assigned on the basis of the molecular quadrupole moments. The a axis is perpendicular to the double bond, and the a and b axes are in the molecular plane. The molecular quadrupole moments in cyclopropene, in units of 10^{-26} esu·cm^2, are $Q_{aa} = -0.4 \pm 0.4$, $Q_{bb} = 2.4 \pm 0.3$, and $Q_{cc} = -2.0 \pm 0.6$. Using the known molecular structure, the diagonal elements of the paramagnetic susceptibility tensor and the anisotropies in the second moment of the electronic charge distribution may be calculated, and they are $\chi^p_{aa} = 56.1 \pm 0.3$, $\chi^p_{bb} = 80.7 \pm 0.2$, $\chi^p_{cc} = 93.4 \pm 0.2$, all in units of 10^{-6} erg/G^2·mole; and $\langle a^2\rangle - \langle b^2\rangle = 4.2_8 \pm 0.2$, $\langle b^2\rangle - \langle c^2\rangle = 7.7_5 \pm 0.2$, and $\langle c^2\rangle - \langle a^2\rangle = -12.0_1 \pm 0.2$, all in units of 10^{-16} cm^2. Although the bulk susceptibility is unknown, a theoretical value of $\langle \frac{1}{r^2}\rangle$ in conjunction with the measured second-moment anisotropies enables the diagonal elements of the diamagnetic and total magnetic susceptibility tensors to be predicted. These are $\chi^d_{aa} = -82.3 \pm 0.3$, $\chi^d_{bb} = -100.4 \pm 0.3$, $\chi^d_{cc} = -133.3 \pm 0.3$, $\chi_{aa} = -26.2 \pm 0.4$, $\chi_{bb} = -19.7 \pm 0.4$, $\chi_{cc} = -39.9 \pm 0.4$, and $\chi_{Av} = -28.6 \pm 0.5$, all in units of 10^{-6} erg/G^2 mole. The sign of the electric dipole moment is obtained from accurately measured g values in the two isotopic species, and gives a polarity of +◁-. (auth)

49790 METASTABLE IONS IN THE MASS SPECTRA OF CD_3CH_3 AND C_2H_6. Loehle, U.; Ottinger, Ch. (Univ., Freiburg i. B.). J. Chem. Phys., 51: 3097-3104(Oct. 1, 1969).

The mass spectra of CD_3CH_3 and C_2H_6 were searched for metastable transitions using a mass spectrometer with high sensitivity. With a detection limit of about 3×10^{-8} of the total ionization, 54 metastable transitions in CD_3CH_3, and 19 in C_2H_6 were found. All of these were checked for possible collision-induced contributions by admitting krypton to the analyzer tube. The CH_3CD_3 decompositions are classified as (a) C–C ruptures, (b) H_2, HD, and D_2 eliminations, and (c) loss of an H or D atom. The first category provides information about D–H scrambling. The rate constant for D–H scrambling prior to C–C rupture is 5×10^4 sec^{-1} for parent ions, but very much larger in fragment ions, with the possible exception of $CH_2CD_2^+$. The second category gives information about the isotope effect between H_2, HD, and D_2 loss. Compared to the loss of H_2, the elimination of HD is diminished about fivefold and that of D_2 by a factor of about 150. In the parent ion much less (if any) D–H scrambling occurs prior to the HD elimination than prior to the C–C rupture, in accord with the expected dependence of the scrambling rate on internal energy. Practically no H_2 and D_2 loss from the parent ion is found, indicating that the mass-28 ion of ethane has the ethylene structure. The H and D losses provide only a few, but very convincing, examples of the strong isotope effect which suppresses D loss in the presence of H by a factor of at least 600. Furthermore, evidence is seen for a secondary isotope effect which slows down the loss of H from $CH_2CD_2^+$ as compared to $C_2H_4^+$. (auth)

49791 VAPOR PRESSURE ISOTOPE EFFECT OF WATER AND ICE. Wolff, H.; Wolff, E. (Univ., Heidelberg). Ber. Bunsenges. Phys. Chem., 73: 393-9(July 1969). (In German).

The vapor pressure ratios of the H_2O/D_2O, H_2O/HDO, H_2O/T_2O, and D_2O/T_2O pairs were calculated from the inter- and the intramolecular vibrations of the compounds. The calculations were made with the uncoupled vibrations in order to avoid errors due to frequency changes of the stretching modes by vibrational interaction in the condensed phases, whether these changes are brought about by coupling with the lattice or by Fermi-resonance with the overtone of the deformation vibration. The calculated ratios agree with the measurements in the literature within the limits of error of the spectroscopic data and of the simplifications of calculation. Within these limits the ratios of the pairs in the liquid state, calculated both with and without the assumption of an equilibrium of free and bonded groups, do not permit distinction between a mixture model of the structure of water with relatively small fractions of free groups and the continuum model. Mixture models with large fractions of free groups are not acceptable because of the wide deviations of the calculated ratios from the measurements. (auth)

49792 CALCULATION OF THE INVERSE VAPOR PRESSURE ISOTOPE EFFECT OF METHYLAMINE, METHANOL, AND OTHER METHYL COMPOUNDS FROM SPECTROSCOPIC DATA. Wolff, H. (Univ., Heidelberg). Ber. Bunsenges. Phys. Chem., 73: 399-403(July 1969). (In German).

The vapor pressure ratios of the pairs $CH_3NH_2-CH_3ND_2$, $CD_3NH_2-CD_3ND_2$, $CH_3NH_2-CD_3ND_2$, $CH_3ND_2-CD_3NH_2$, and CH_3OH-CH_3OD in large dilution with hexane and those of the pairs $CH_3NH_2-CD_3NH_2$, $CH_3ND_2-CD_3ND_2$, CH_3I-CD_3I, and CH_3Br-CD_3Br in the undiluted state were calculated neglecting the contribution of the intermolecular vibrations. The calculated values approximate the ratios found previously by measurements of vapor pressures to the extent that the inverse vapor pressure isotope effect is caused primarily by the changes of the intramolecular vibrations brought about by solvation or condensation (under exclusion of association) of the molecules. The contribution of the intermolecular vibrations can be largely neglected: in the case of the associated compounds the intermolecular vibrations are nearly equal within each pair; in the case of monomers the intermolecular vibrations are low in frequency or rotationlike and approximate the classical behavior of vibrations. (auth)

49793 ISOTOPE EFFECTS ON THE REACTIONS OF ^{82}Br ACTIVATED BY ISOMERIC TRANSITION BETWEEN CH_4 AND CD_4. Tachikawa, Enzo (Japan Atomic Energy Research Inst., Ibaraki). Bull. Chem. Soc. Jap., 42: 2404(Aug. 1969).

A study is described of the influence of the moderator gas on the individual products from both the $^{82m}BrCH_4$ and the $^{82m}BrCD_4$ systems. The study was made in order to ascertain the isotope effects on the energetic and also on the thermal ionic reaction process. It was concluded that there is an isotope effect between CH_4 and CD_4 in the energetic reaction but not in the thermal ionic reactions. Possible sources for the observed isotope effect in the energetic reaction considered were the moderator isotope effect, the probability-integral isotope effect, and the average-energy isotope effect. (D.H.M.)

49794 THE EFFECT OF THE IMIDAZOLE GROUP ON THE HYDROLYSIS OF N-[2-(4-IMIDAZOLYL)ETHYL]PHTHALIMIDE. Su, S. C. K.; Shafer, J. A. (Univ. of Michigan, Ann Arbor). J. Org. Chem., 34: 2911-15(Oct. 1969).

The pH dependencies (at 25°C) of the pseudo-first-order rate constants for the hydrolysis (to phthalamic acids) of N-[2-(4-imidazolyl)ethyl]phthalimide (1), N-(2-trimethylaminoethyl) phthalimido bromide (2), N-(3-trimethylaminopropyl)phthalimido bromide (3), and N-methylphthalimide (4) were determined. The cationic imides 2 and 3 are most susceptible to hydroxide ion catalyzed hydrolysis. Below pH 7, however, 1 hydrolyzes most rapidly. This effect was ascribed to the neighboring imidazole residue functioning as a general base in catalyzing attack by water. A deuterium oxide solvent isotope effect of 2.1 is associated with this process. The possibility that this effect reflects the susceptibility of the protonated form of 1 to attack by hydroxide ion was deemed unlikely, since the second-order rate constant for this reaction would be 333 sec^{-1} M^{-1}, while the second-order rate constants for the hydroxide ion catalized hydrolysis of cationic imides 2 and 3 with their positive charges closer to the carbonyl carbon atom are 91 and 41 sec^{-1} M^{-1}, respectively. Also, cationic imides 2 and 3 are susceptible to direct attack by water, whereas the protonated form of 1 is much less susceptible to attack by water. It is unlikely that a neighboring imidazole residue functions as a general acid in catalyzing attack by hydroxide ion, since the calculated rate constant for this process is not significantly lowered by deuterium oxide. The first-order rate constants for intramolecular catalysis of the hydrolysis of 1 by the neighboring imidazole group (2.9×10^{-5} sec^{-1}) was found to be similar in magnitude to the second-order rate constant for the imidazole-catalyzed hydrolysis of 4 (2.0×10^{-5} sec^{-1} M^{-1}). (auth)

49795 EFFECT OF THE LEAVING GROUP ON RELATIVE REACTIVITY AND PRODUCTS IN SOLVOLYSIS. Smith, Stanley G.; Goon, David J. W. (Univ. of Illinois, Urbana). J. Org. Chem., 34: 3127-31(Oct. 1969).

Phenyldimethylcarbinyl chloride, p-nitrobenzoate, and thionbenzoate were found to be more reactive than the corresponding benzhydryl compounds by factors of 5.5, 23, and 4700, respectively, in ethanolysis at 50°C. For the cumyl derivatives, kinetic isotope effects and solvolysis products are consistent with an ionization-type reaction for the three leaving groups. The results are interpreted in terms of an observed kinetic isotope effect containing contributions from the isotope effect on elimination from the carbonium ion because of ion-pair return. The high reactivity of cumyl thionbenzoate is attributed to a decrease in the importance of ion-pair return in this system relative to the model compounds. (auth)

49796 ISOTOPIC EXCHANGE IN CH_4–D_2 AND CD_4–H_2 MIXTURES STUDIED BY ION CYCLOTRON RESONANCE SPECTROSCOPY. THE MECHANISM OF SELF-INDUCED LABELING OF METHANE BY TRITIUM. Inoue, M.; Wexler, S. (Argonne National Lab., Ill.). J. Amer. Chem. Soc., 91: 5730-40(Oct. 8, 1969).

The mechanisms of isotopic exchange of hydrogen atoms in the ionic reactions in CH_4-D_2 and in CD_4-H_2 mixtures were investigated by the technique of ion cyclotron resonance spectroscopy. The chains of competitive and consecutive ion–molecule reactions leading from the primary ions produced by electron impact to ethyl ions with none, one, two, or three of their hydrogen atoms replaced by deuterium were established from studies of CH_4-D_2 mixtures and confirmed with CD_4-H_2 mixtures. Isotopically labeled methyl ions are formed in reactions of D_3^+ with CH_4 and of methyl ions with D_2, and these then react with methane to give the labeled ethyl ions. The latter are inert toward D_2 and only slightly reactive with CH_4. Xenon and nitric oxide inhibit the production of the tagged ethyl ions initiated by reactions of D_3^+ and D_2^+, but have little effect on their formation by chains of reactions beginning with CH_3^+ from methane. The sequences of ionic reactions observed should be the same as those which occur in the "Wilzbach labeling" of methane by tritium, in which tritium is present rather than deuterium, and the ionization and excitation are initiated internally by β particles and secondary electrons. Mechanisms involving only ionic and ionic followed by free-radical reactions are proposed for the Wilzbach labeling of methane. (auth)

49797 SECONDARY ISOTOPE EFFECTS IN THE DEHYDRATION OF MALIC ACID BY FUMARATE HYDRATASE. Schmidt, Donald E. Jr.; Nigh, Wesley G.; Tanzer, Christian; Richards, John H. (California Inst. of Tech., Pasadena). J. Amer. Chem. Soc., 91: 5849-54(Oct. 8, 1969).

The kinetic isotope effects for the dehydration by fumarate hydratase of 2-^{3}H-1,4-^{14}Cl-1-malic acid and 2,3-^{3}H-1,4-^{14}C-1-malic acid were determined and support a carbonium ion mechanism for the enzymatic reaction. The isotope effect on the equilibrium between l-malate and fumarate was also determined experimentally and agrees closely with that anticipated on the basis of a Bigeleisen treatment. (auth)

49798 TEMPORARY ATTACHMENT OF ELECTRONS TO AZULENE-h_8 AND AZULENE-d_8. Compton, R. N. (Oak Ridge National Lab., Tenn.); Huebner, R. H. J. Chem. Phys., 51: 3132-3(Oct. 1, 1969).

At low sample gas pressures the molecular negative ions of deuterated and normal azulene occurred only for electrons incident with approximately thermal energies. Negative-ion lifetimes for $C_{10}H_8^{-*}$ and $C_{10}D_8^{-*}$ are tabulated. Results indicate that C–H or C–D vibrations are not effective in trapping the electron and that C–C skeletal vibrations and possible ring distortion act to capture the electron. (J.G.B.)

49799 KINETIC ISOTOPE EFFECTS. PART 5. BROMINATION OF ACETOPHENONE-d_3 AND INTER-RELATIONSHIP BETWEEN DEUTERIUM AND TRITIUM ISOTOPE EFFECTS. Jones, J. R. (Univ. of Surrey, London). Trans. Faraday Soc., 65: 2138-43(Aug. 1969).

Measurements are reported on the bromination of acetophenone-d_3 in alkaline media and over a temperature range. Taken in conjunction with the previously reported rates of deprotonation and detritiation, it is possible to draw certain conclusions concerning Swain's equation for relating deuterium and tritium isotope effects. It is suggested that the relationship may be employed for predicting the possible magnitude of secondary isotope effects in some reactions, although it is unlikely to provide a sensitive means of probing possible quantum mechanical contributions where the latter are small. For a number of proton transfer reactions for which the transition states differ markedly from one another the relationship holds well. Measurements on the rates of ionization of acetone at 25° were in good agreement with those obtained previously. In this case the transition state is more symmetrical than for a number of acetophenones. Consequently the tunnelling contribution is higher, and when a statistical factor of six is inserted for the detritiation results it is sufficient to lower the correlation factor from the value of 1.44 to 1.12. (auth) (UK)

49800 REINTERPRETATION OF THE ESR SPECTRUM OF NH_2, NHD, AND ND_2 IN ARGON AT 4°K. Cochran, Edward L.; Adrian, Frank J.; Bowers, Vernon A. (Johns Hopkins Univ., Silver Spring, Md.). J. Chem. Phys., 51: 2759-61(Sept. 15, 1969).

An ESR spectrum of the NH_2, NHD, and ND_2 products of the photolysis of partially deuterated NH_3 in argon at 4°K, better-resolved than that previously reported, was used in an attempt to assign lines of the spectrum to various isotopic species. Isotropic magnetic constants of NH_2 and NHD were calculated. (J.G.B.)

49801 SOME OBSERVATIONS ON THE CHEMISTRY OF NEPTUNIUM IN BASIC SOLUTION. Cohen, D.; Fried, S. (Argonne National Lab., Ill.). Inorg. Nucl. Chem. Lett., 5: 653-63(Aug. 1969).

A study is described of the oxidation of Np(IV), (V), and (VI) in the presence of various bases, both electrolytically and by alkaline fusion. It was found that Np can be easily oxidized by alkaline fusion, and that even Np(VII) could be obtained in this way. Its chemistry in tetramethylammonium hydroxide was of special interest, this being a strong base which can give reasonably concentrated aqueous solutions, and which shows extraordinary solvent properties for some of the actinides. It was possible to obtain high neptunyl concentrations and study its solution as an anion. Np(V) was also found to be soluble in TMAH and to exist unexpectedly as an anion in this solution, thus showing an amphoteric nature. It was shown that anionic Np(V) exists also in various alkaline media. Methods of preparation of these solutions are described, with special emphasis on Np(V), and the evidence for the existence of the various species is presented. (UK)

49802 RADIOIODINATION OF LATEX PARTICLES. Singer, Jacques M. (Montefiore Hospital, Bronx, N. Y.); Van Oss, Carel J.; Vanderhoff, John W. RES. J. Reticuloendothel. Soc., 6: 281-6(June 1969).

A simple method was developed for radioiodination of polystyrene latex particles. Since commercially available polystyrene particles cannot be radioiodinated, styrene was copolymerized with butadiene to introduce reactive double bonds with which the radioisotope can react. The particles produced were of the same size (2290 to 2350 Å) and their size distribution was narrow. The concentrations of butadiene were just sufficiently large to allow the incorporation of detectable radioiodine, but still small enough

to affect the physical properties of the polymer only negligibly. After radioiodination with ^{131}I and ^{125}I, measurement of the radioactivity of the particles indicated that from 12 to 29% of the initial radioiodine had remained bound to the particles. Radioiodinated latex particles were employed for in vivo studies of blood clearance and phagocytosis; to formulate a mathematical description of the in vivo distribution of injected particles; to determine the influence of surface changes on the localization of latex; and for long-range tracer and metabolic studies of the redistribution and elimination of injected particles in rabbits and mice. These particles were also used as a carrier for adsorbed protein antigens, labeled with a different isotope so that the possibly different pathways of both carrier and antigen may be followed simultaneously. (BBB)

49803 FRAGMENTATION OF ORGANIC COMPOUNDS ON ELECTRON IMPACT. VI. DIDEUTERIOOCTANES. Weinberg, D. S.; Scoggins, M. W. (Phillips Petroleum Co., Bartlesville, Okla.). Org. Mass. Spectrom., 2: 553-65(June 1969).

A fragmentation model was sought which would allow the distribution of peaks produced on electron-impact by dideuteriated alkanes to be calculated from the distribution of peaks produced by the unlabeled alkane and the position of the deuterium in the labeled compound. Such a model assumes that: no scrambling of D and H occurs in the molecular ion before or during fragmentation; D isotope effects do not change the probability of cleavage of carbon–carbon bonds; n-dideuterioalkanes undergo random cleavage of carbon–carbon bonds followed by the loss of hydrogen atoms; and branched dideuterioalkanes undergo cleavage exclusively at points of branching, followed by loss of hydrogen atoms. These assumptions are sufficiently valid to allow prediction of mass spectra. Eleven isomeric octenes were converted to the corresponding dideuterio derivatives and their mass spectra found to agree well with the prediction of the model. Thus it is possible to specifically saturate C–C double bonds in selected octenes with D and the mass spectral fragmentation patterns of the dideuteriated octanes can be calculated if the C skeleton is known. The information obtained can then be used to determine the position of the double bond in the original olefin. (BBB)

49804 STABILITY AND POLYMERIZATION OF URANYL–CATECHOL CHELATES. Verma, S. K.; Agarwal, R. P. J. Prakt. Chem., 38: 280-8(Nov. 1968).

On the basis of the strong tendency of the uranyl ion and its catechol chelate to undergo polymerization in aqueous solutions, a systematic physicochemical study was made of this system. Attempts were also made to determine the stability and polymerization constants of the chelate. The interaction was investigated by potentiometric and spectrophotometric techniques. Potentiometric titrations of uranyl nitrate with caustic potash in presence of catechol exhibited a sharp inflection at $2\frac{2}{3}$ moles of alkali per mole of the metal ion. At the initial stages of the titration, the reaction was shown to proceed as: $UO_2^{2+} + C_6H_4(OH)_2 \rightleftharpoons UO_2C_6H_4O_2 + 2H^+$. The equilibrium constant of the reaction was found to be 2.88×10^{-7}, giving a value of 3.87×10^{14} for the formation constant of the chelate. The equilibrium constant of the reaction $2UO_2^{2+} + 2H_2A \rightleftharpoons (UO_2A)_2 + 4H^+$ was found to be 1.00×10^{-19}. The binuclear chelate species was found to polymerize further through hydrolytic reactions. (BBB)

49805 DETERMINATION OF THE FIRST HYDROLYSIS CONSTANT OF AMERICIUM, CURIUM, BERKELIUM, AND CALFORNIUM. Desire, Bernard; Hussonnois, Michel; Guillaumont, Robert (Institut de Physique Nucleaire, Orsay, France). Compt. Rend., Ser. C, 269: 448-51(Aug. 18, 1969). (In French).

The values of the first hydrolysis constant, K_1, of the cations M^{3+} (M is Am, Cm, Bk, Cf) were determined for a medium with an ionic strength of 0.1. The acidity of these cations increases slightly with the atomic number. Log $K_1 = -5.92$ for Am^{3+} and Cm^{3+}, -5.66 for Bk^{3+}, and -5.62 for Cf^{3+}. (tr-auth)

49806 UO_2-COMPLEXES WITH PHENOLIC LIGANDS. XII. SPECTROPHOTOMETRIC STUDY OF REACTION OF UO_2^{2+} WITH GALLIC ACID. Havel, J.; Sommer, L. (Purkyne Univ., Brno). Collect. Czech. Chem. Commun., 34: 2674-2715(Sept. 1969).

Reactions of complexes of uranyl with 3,4,5-trihydroxybenzoic acid (gallic acid) were studied by means of spectrophotometric methods. A much more complicated reaction mechanism than the one that was observed in a variety of ortho- and para-diphenols was found. A method for the spectrophotometric determination of U in pure solutions using gallic acid is described. (P.C.H.)

49807 SEVEN CO-ORDINATE URANYL COMPOUNDS OF THE PLANAR QUINQUEDENTATE LIGAND N,N'-BIS-SALICYLIDENE-1,5-DIAMINO-3-AZAPENTHANE. Akhtar, M. N.; McKenzie, E. D.; Paine, R. E.; Smith, A. J. (Univ. of Sheffield, Eng.). Inorg. Nucl. Chem. Lett., 5: 673-7(Aug. 1969).

This ligand (abbreviated as saldien) is not sufficiently flexible to act as a quinquedentate ligand in octahedral or five-coordinate geometry in compounds which have a metal to donor atom distance of ~2Å, as in the case of the first row transition metal compounds. A study of molecular models, however, indicates that for a significantly greater metal to donor atom distance (2.3 to 2.5 Å) saldien should function as a planar quinquedentate ligand, with a stable conformation of its aliphatic chain. This ligand should thus be particularly suitable for the preparation of a series of seven coordinate metal compounds with large cations of the UO_2^{2+} type. Following the procedure described in J. Prakt. Chem. 26: 130 (1964) an orange ethanol solvate, UO_2 saldien. EtOH, was obtained; recrystallization of this from acetonitrile gave a mixture of bright orange needles and orange-yellow prisms, the latter being α-[UO_2 saldien], the x-ray crystal structure of which indicated seven-coordinate geometry. Crystal data for this compound are given, together with its structure, principal interatomic distances and angles. The bright orange needles from the acetonitrile recrystallization were β-UO_2 saldien. CH_3CN, the crystal structure for which is also given, together with crystal data for the original ethanol solvate UO_2 saldien. EtOH. A β-form of UO_2 saldien. EtOH was also obtained, which gave UO_2 saldien. C_6H_6 with benzene and UO_2 saldien. $CHCl_3$ with chloroform. It is concluded that the β-form represents a metastable form of the complex, which is stabilized in the various crystalline structures of the solvates. The difference in structure of the two forms can be rationalized in terms of different conformations of the quinquedentate ligand. (UK)

49808 SPECTROPHOTOMETRIC STUDIES ON THE COMPOSITION, STABILITY, AND ANALYTICAL APPLICATIONS OF LANTHANUM(III) : 1,2,5,8-TETRAHYDROXYANTHRAQUINONE (QUINALIZARIN) CHELATE IN SOLUTION. Srivastava, K. C.; Banerji, Samir K. (Birla Inst. of Tech. and Science, Pilani, India). J. Prakt. Chem., 38: 327-38(Nov. 1968).

The formation of lanthanum quinalizarin chelate is reported for the first time, along with the composition, nature, and stability of the chelate. The violet-colored chelate of La(III) with quinalizarin was studied in 50% ethanolic medium by the spectrophotometric method. Suitable conditions for its use in the micro determination of La were investigated and are described. The absorbance curves of the complex showed a maximum at 530 mμ. The composition of the chelate was determined by 3 methods. The molar ratio of the metal to chelating agent is 1:2. The chelate is soluble in aqueous ethanol and is stable between pH 6.5 and 7.2. Maximum color formation is attained at pH 6.8, when the mixture contains greater than a 5-fold excess of the reagent with respect to the metal solution, and the color intensity remains unaltered even after the mixture stands 3 hr at room temperature. The stability constant of the chelate was calculated by 3 different methods (1, 2, 3). The values of log K in 50% ethanolic medium at 30° are, respectively, (1) 10.1 ± 0.1, (2) 10.2 ± 0.1, (3) 10.1 ± 0.1 and the free energies of formation at the same temperatures are (1) −14.0 ± 0.1, (2) −14.1 ± 0.1, (3) −14.0 ± 0.1 Kcal. The range of concentration for adherence to Beer's Law and the value of optimum concentration range are 1.26 to 6.32 ppM and 1.4 to 3.5 ppM. Optimum conditions for the spectrophotometric determination of La are presented. (BBB)

49809 FORMATION OF COMPLEX COMPOUNDS BETWEEN URANYL NITRATE AND NITRATE OF THE SECOND GROUP ELEMENTS. THE SYSTEM: $Hg_2(NO_3)_2$–$UO_2(NO_3)_2$–H_2O (CONDUCTIVITY, REFRACTIVE INDEX, SPECTROPHOTOMETRY, AND pH). Gupta, S. S.; Sharga, B. N. (Luknow Univ., India). J. Prakt. Chem., 38: 301-4(Nov. 1968).

A study of the physicochemical properties (including refractive index, spectrophotometry, conductivity, and pH measurements) of a series of mixed solutions of uranyl nitrate and mercurous nitrate showed the existence of 2 complexes in solution in 1:1 and 1:2 molecular ratios, respectively, namely: $UO_2(NO_3)_2 \cdot Hg_2(NO_3)_2$ and $UO_2(NO_3)_2 \cdot 2\,Hg_2(NO_3)_2$. These 2 compounds were detected in the solution by the breaks in the concentration curves when various parameters such as conductivity, refractive index, spectrophotometry, and pH were plotted against the number of milliliters of mercuric nitrate (0.1 M) added to a fixed volume of uranyl nitrate (0.1 M). There was a close similarity in the curves with respect to all of the physicochemical properties investigated and therefore there was little doubt about the genuineness of these associations. The breaks occurred at exact stoichiometric ratios of concentrations corresponding to the compounds given above. Thus the existence of these compounds becomes unequivocal when such dissimilar properties as conductance, refractive index, spectrophotometry, and pH measurements yield similar results. (BBB)

49810 OCTAHEDRAL COMPLEXES OF URANIUM(IV). II. MAGNETIC AND SPECTRAL EFFECTS OF TETRAGONAL DIS-

TORTION. Lane, B. C.; Venanzi, L. M. (State Univ. of New York, Albany). Inorg. Chim. Acta, 3: 239-45(June 30, 1969).

The electronic spectra and magnetic susceptibilities of the complexes $[UCl_4L_2]$ and $[UBr_4L_2]$ (L = Et_3PO, Ph_3AsO) were measured. Relative values of the nephelauxetic and ligand field effects for these and similar complexes were derived and used to explain the magnetic behavior. Infrared data are reported in support of the proposed structures. Preparation of the starting materials and the complexes is described in detail. Complexes $[UX_4L_2]$ (X = Cl, Br; L = Ph_3PO, Et_3PO, Ph_3AsO, Et_3AsO) were assigned trans-configurations on the basis of their ir spectra. This assignment is supported by the visible and uv spectra, which consist of a sharp weak bands characteristic of vibronic spectra, which are only found in centrosymmetric environments where the u ↔ g selection rule is applicable. Absorption spectra for 27,000–4000 cm^{-1} were obtained for all the solid complexes by diffuse reflectance techniques. In all cases intense absorption occurs above 27,000 cm^{-1} and a few broad bands appear. The principal bands in all the spectra are tabulated. These spectra consist of series of weak sharp bands. (BBB)

49811 OPTICAL ASPECTS OF DIELECTRIC PENETRABILITY AND CHEMICAL BOND IN RARE EARTH SULFIDES. Kustova, G. N.; Obzherina, K. F.; Kamarzin, A. A.; Dulenov, E. V.; Derbeneva, S. S.; Batsanov, S. S. (Inst. of Thermal Physics, Novosibirsk, USSR). Zh. Strukt. Khim., 10: 609-12(Aug. 1969). (In Russian).

The ir spectra of rare earth sulfides were studied in the 220 to 5000 cm^{-1} region on the UR-10 and IRS-21 spectrometer with a CsI crystal. Electron spectra were also obtained for the region of 200 to 1000 mμ. The immersion method was used for determining the dielectric penetration of powdered rare earth sulfides. The Szigeti method was used for estimating the magnitudes of effective charges. The densities, measured by the pycnometric method, and the diffraction indices, determined by a spectrometric method, are tabulated. (tr-auth)

49812 ELECTRON PARAMAGNETIC RESONANCE OF THE U^{3+} IONS IN $CaMoO_4$. Baikova, R. A.; Kurkin, I. N.; Shekun, L. Ya. (Kazan State Univ.). Zh. Strukt. Khim., 10: 731(Aug. 1969). (In Russian).

Crystals of $CdMoO_4$, $CaMoO_4$, and $SrMoO_4$ obtained by the Czochralski method and activated by uranium introduced in the form of UO_3 and $BaMoO_4$ crystals obtained by a method of "solution in a melt" were studied by the EPR method at ~9.4 Hz frequency at liquid He temperature using a radiospectroscope. The results showed that U ions diffuse poorly into the sheelite-type structure. (R.V.J.)

49813 EXCHANGE OF HYDROGEN ISOTOPES BETWEEN ICE AND WATER IN TEMPERATE GLACIERS. Arnason, Bragi (Univ. of Iceland, Reykjavik). Earth Planet. Sci. Lett., 6: 423-30(Sept. 1969).

Isotopic exchange between ice and water was found to take place in temperature glaciers. This exchange causes homogenization of deuterium in snow during summer thaws, together with a general increase in deuterium concentration. Ice in a temperature glacier is therefore more homogeneous and has a higher deuterium concentration than the precipitation on the glacer. The difference between the average deuterium concentration in ice and precipitation gives information about the runoff ratio. (auth)

49814 LEAVING GROUP EFFECTS IN SOLVOLYSIS REACTIONS. SECONDARY DEUTERIUM ISOTOPE EFFECTS. Goon, David James Wong. Chicago, Univ. of Illinois, 1968. 178p. Thesis.

The rates and products of solvolyses in ethanol and methanol of cumyl-β-d_3 and -d_6 chloride, p-nitrobenzoates and thionbenzoate were determined and compared with those of the corresponding undeuterated derivatives. The observed kinetic isotope effects on the solvolyses of the chlorides and p-nitrobenzoates appear to be cumulative while those on the solvolyses of the thionbenzoates are just outside of experimental error of being so. The phenomenon of cumulative effects is interpreted in terms of a transition state in which the effect of each methyl group of the cumyl moiety is chemically equivalent with respect to the leaving group. In changing the solvent from ethanol to methanol the apparent isotope effects on the elimination and substitution steps, calculated from the observed rate constants of solvolysis and the observed product distributions, are the same in both solvents. However, a smaller fraction of elimination in methanol results in change in the measured gross isotope effect for this solvent change. These results are consistent since the measured gross isotope effect is not necessarily equal to the sum of the apparent isotope effects on each process of solvolysis. A comparison of the rates of solvolysis of the cumyl derivatives with those of the corresponding benzhydryl derivatives indicates specific leaving group effects with the reactivity of the cumyl system being much more sensitive to the nature of the leaving group than the benzhydryl system. (D.H.M.) (Disser. Abstr.)

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Refer also to abstracts 49958, 50041, 50052, 50225, 50331, 50674, 50835, 50934, 50960, 51150, 51758, 51779, and 51857.

49815 (BNWL-1051(Pt.2), pp 158-60) LONG-LIVED ORGANIC RADICALS FORMED BY IRRADIATION OF FD AND C BLUE NO. 2 IN AQUEOUS SOLUTION. Kalkwarf, D. R.; Diebel, R. N. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

ESR spectral studies were made on helium-sparged aqueous solutions of FD&C Blue No. 2. The results showed that free radicals were present throughout the pH range 7.6 to 13. Radical concentration increased with pH and with addition of ethanol prior to irradiation. Still higher radical yields were obtained by reducing FD&C Blue No. 2 with sodium dithionite, allowing better resolution of hyperfine structure. It was concluded that identical radicals were formed by the two processes. The ESR spectrum of the radical together with the chemical conditions required for its formation showed that it was the product of electron addition to the dye. It was concluded that due to its ability to form a long-lived radical, FD&C Blue No. 2 can at least slow down the chain of reactions leading to radiobiological damage so that natural repair mechanisms can be more effective. (P.C.H.)

49816 (BNWL-1051(Pt.2), pp 161-2) REDUCING RADICALS FORMED DURING GAMMA RADIOLYSIS OF SELECTED BIOCHEMICALS. Diebel, R. N. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Nitrobenzene radical ions were used as indicators for the production of reducing species in the γ radiolysis of solutes. The enhancement of the ESR signal amplitude in the basic solution of 10^{-3} M nitrobenzene is due to the scavenging of OH radical by the added solute. Production of an ESR signal in the presence of N_2O, an added solute, is evidence for the production of a reducing species (radical). It was concluded that the enhancement of the ESR signals appears to be a combination of hydroxyl radical scavenging and production of reducing species. (P.C.H.)

49817 (BNWL-1051(Pt.2), pp 204-5) LUMINESCENCE KINETICS FOLLOWING PULSED PROTON IRRADIATION. West, M. L.; Nichols, L. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Preliminary results are reported for pulse studies on benzene, toluene, and solutions of p-terphenyl in cyclohexane, toluene, and xylene. The luminescence curves of benzene, toluene, and p-terphenyl in cyclohexane exhibited rise times that were limited only by the system resolution, while those of p-terphenyl in toluene and xylene were noticeably longer and depended on solute concentration. The observed rise time revealed the transfer time of electronic energy between molecules and its dependence on molecular concentration. (P.C.H.)

49818 (JINR-E15-4651) NEWEST ELEMENTS OF THE MENDELEEV PERIODIC TABLE. PERSPECTIVES AND CHEMICAL PROBLEMS OF THE SEARCH FOR SUPER-HEAVY ELEMENTS. Flerov, G. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1969. 27p. Dep. CFSTI (U. S. Sales Only).

The state of investigations on the synthesis and properties of far-transuranium elements is considered. Perspectives and chemical problems in the search for super-heavy elements are analyzed. The possibilities of accelerators in this respect are considered. The possible existence of super-heavy elements in cosmic rays and minerals is discussed. (auth)

49819 (UCRL-18667, pp 313-21) RADIATION CHEMISTRY. (California Univ., Berkeley. Lawrence Radiation Lab.).

ACETALDEHYDE—yields from γ radiolysis of oxygen-free solutions of acetamide
ACETAMIDE—radioinduced reduction in oxygen-free solutions, effects of cysteine on yields from γ
—radiolysis of oxygen-free solutions of, yields from γ
ACETAMIDE, N-ETHYL- —radioinduced reduction in oxygen-free solutions, effects of cysteine on yields from γ
ALANINE—radiolysis of solid, yields from γ
—polymers, radiolysis of, yields from γ
ALANINE, N-ACETYL- —radiolysis of, yields from γ
—radiolysis of solid, yields from γ
ALANINE, N-ACETYL-3-PHENYL- —radiolysis of solid, yields from γ

ALANINE, 3-(METHYLSULFINYL)- — radiolysis of solid, yields from γ
AMMONIA — yields from γ radiolysis of solid cysteine and related compounds
BUTYRIC ACID, 2-ACETAMIDO- — radiolysis of solid, yields from γ
CYSTAMINE — radiolysis of solid, yields from γ
CYSTEINE — radiolysis of solid, mechanism and yields from γ
CYSTEINE, N-ACETYL- — radiolysis of solid, yields from γ
CYSTINE — yields from γ radiolysis of solid cysteine
GLUTAMIC ACID, N-ACETYL- — radiolysis of solid, yields from γ
GLYCINE — radiolysis of solid, yields from γ
GLYCINE, N-ACETYL- — radiolysis of solid, yields from γ
HYDROGEN — yields from γ radiolysis of solid cysteine and related compounds
— yields from γ radiolysis of oxygen-free solutions of acetamide
HYDROGEN SULFIDES — yields from γ radiolysis of solid cysteine and related compounds
LEUCINE, N-ACETYL- — radiolysis of solid, yields from γ
METHIONINE, N-ACETYL- — radiolysis of solid, yields from γ
SUCCINAMIDE — yields from γ radiolysis of oxygen-free solutions of acetamide
TYROSINE, N-ACETYL- — radiolysis of solid, yields from γ (P.C.H.)

49820 INVESTIGATIONS OF PARAMAGNETIC CENTERS IN SULFOPHENOL AND SULFOSTYRENE MACROMOLECULES. Furnica, G. (Institut fuer Hygiene, Bucharest); Constantinescu, O. Radiochim. Acta, 12: 85-8(Aug. 1969). (In German).

ESR measurements of polysulfophenol and polysulfostyrol ion exchange substances after irradiation with ionizing radiation revealed the presence of free radicals associated with the chemical bond C–SO_3H. ESR measurements on non-irradiated samples of the type of substances described above have indicated the presence of free radicals already before irradiation. The conditions for the treatment of the ion exchange materials (e.g., drying in air instead of vacuum) have a remarkable influence on the ESR spectra. The formation of complexes with UO_2^{2+} or Po^{4+} and Pu^{4+} ions and subsequent drying in air or vacuum give rise to an ESR signal that can also be observed with samples dried in vacuum before complexation. Furthermore, the amount of water adsorbed from the air has also shown to influence considerably the ESR spectra of the ion exchange resins. (auth)

49821 SZILARD–CHALMERS REACTION IN AMMONIUM PERRHENATE CRYSTALS. De Kimpe, A. G.; Apers, D. J.; Capron, P. C. (Univ., Louvain, Belg.). Radiochim. Acta, 12: 113-15(Aug. 1969).

Studies were made on the retention of Re during the Szilard–Chalmers reaction in ammonium perrhenate crystals by working at temperatures lower than usual. Samples were irradiated for 10 min in the BR 1 reactor, Mol, at a nominal thermal neutron flux of 2.1×10^{11} cm^{-2} sec^{-1}. The associated γ dose rate was 10^5 rads/hr. Annealing experiments were performed in liquid propane, liquid freon or melting ice for low temperatures. The retention in ammonium perrhenate irradiated and dissolved at low temperature amounted to 52%. This value increased on isothermal annealing to reach values that were characteristic for the annealing temperature. From the results it was concluded that in ammonium perrhenate the recoil atom tends to stabilize in the crystal in a form that reacts or hydrolyzes in water to form perrhenate ions, while an insoluble compound is formed in liquid ammonia. On annealing this momentarily stabilized form returns to perrhenate or to chlororhenate according to the matrix in which it has been inoculated. (P.C.H.)

49822 COMPARATIVE RADIOSENSITIVITY OF THYMINE AND ITS ANALOGUES (5-HALO-URACILS) IN ESCHERICHIA COLI. Guillet, L.; Nofre, C. (Centre de Recherches du Service de Sante des Armees, Lyon). Compt. Rend. Soc. Biol., 162: 3242-6(1968). (In French).

A study was made of the radiodehalogenation of 5-halouracil incorporated in the DNA of Escherichia coli. The destruction of the uracils was compared with that of thymine under the same conditions. The irradiations were made with ^{60}Co γ rays. The analysis of the products obtained after irradiation of bacteria which were not treated with halogen analogues and whose DNA is then only labeled with ^{14}C-2-thymine shows that thymine is partially degraded with formation of urea and a nonidentified product (product X). Increase of the irradiation dose does not affect greatly the quantity of urea obtained but increases significantly that of product X. The appearance of product X and the disappearance of thymine is more marked in the presence of air than under nitrogen atmosphere. The radiosensitivity of bromouracil is about 1.7 times greater than that of chlorouracil. The radiosensitivity is more marked in nitrogen atmosphere than in the presence of air. (J.S.R.)

49823 EXCITATION FUNCTIONS FOR THE FORMATION OF ^{68}Ge, ^{65}Zn, AND ^{22}Na IN IRRADIATION OF ZINC AND ALUMINUM WITH α PARTICLES. Karpeles, Alfredo (Kernforschungszentrum, Karlsruhe, Ger.). Radiochim. Acta, 12: 115-17(Aug. 1969). (In German).

The targets were zinc and aluminum foils in the internal beam of the Karlsruhe isochrocyclotron. The cross-sections for production of ^{68}Ge, ^{65}Zn, and ^{22}Na were calculated from the measured activities. (M.C.G.)

49824 BIMODAL MOLECULAR WEIGHT DISTRIBUTIONS IN THE γ-RAY INDUCED POLYMERIZATION OF STYRENE AT LOW TEMPERATURES. Huang, Robert Y. M.; Westlake, John F. (Univ. of Waterloo, Ont.). J. Polym. Sci., Part B, 7: 713-17 (Oct. 1969).

Results are reported for γ-induced polymerization of styrene at −10°C, which indicates that the molecular weight distribution of polystyrene is quite broad and distinctly bimodal. Evidence is postulated for the coexistence of two propagating species: one free radical and the other cationic. It was concluded that the water content of the sample is the key factor responsible for the situation. Since ionic and free radical polymerization occur in "dry" and "wet" systems, respectively, the results strongly indicate the existence of a transition region (with respect to water concentration) in which both a free radical and a cationic mechanism are operative. (D.H.M.)

49825 ESR DETECTION OF N_2O^+ IN γ-IRRADIATED N_2O AT 77°K. Smith, D. R.; Seddon, W. A. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Chem. Phys. Lett., 3: 640-2(Aug. 1969).

Gamma irradiation of solid N_2O at 77°K results in the formation of at least three different radical species. The detection of a new radical species containing two non-equivalent nitrogen atoms is reported. Data indicate this species is N_2O^+ since the major hyperfine splitting arises from the terminal nitrogen. (auth)

49826 PREPARATION OF A SOURCE OF $^{171}Lu_{71}$. Antony, M. (Univ., Strasbourg). Curr. Sci. (India), 38: 464-5 (Oct. 5, 1969).

The preparation of a thin source of ^{171}Lu for β spectroscopy is described. The internal beam of the α particles hit a target of ^{169}Tm with an intensity of 5 microamperes, the total charge on the target support being 35 microampere-hr, and the energy of the projectile 30 MeV. After chromatographic separation using α-hydroxyisobutyric acid the Lu was electrodeposited. The source was then placed in a semicircular spectrograph to study the low energy conversion electron spectra. (D.H.M.)

49827 ANNEALING OF TRISDIPYRIDYLCOBALT(III) PERCHLORATE CRYSTALS. PARTICIPATION OF BULK AND CORRELATED DEFECTS. Khorana, S.; Wiles, D. R. (Carleton Univ., Ottawa). Radiochim. Acta, 12: 111-12(Aug. 1969).

Irradiation of Fe-doped trisdipyridylcobalt(III) perchlorate crystals labeled with ^{58}Co was carried out in a reactor thermal column. A progressive decrease in the ^{58}Co exchange rate was observed as the Fe concentration increased. A distinct induction period was observed, which appeared to be longer for higher Fe concentrations. The results for transfer annealing of doped samples and for the second stage of recoil annealing of doped samples were strongly similar and suggested that the two reactions proceed by very similar mechanisms. (M.C.G.)

49828 RADIATION INDUCED CARBONYLATION OF PHENOL. Seitner, D.; Getoff, N. (Max-Planck-Institut fuer Kohlenforschung, Muelheim an der Ruhr, Ger.). Z. Phys. Chem. (Frankfurt), 66: No. 1-3, 22-33(July 1969). (In German).

The radioinduced carbonylation of aqueous phenol saturated with CO was studied in respect to the formation of salicylaldehyde. Its yield was followed as a function of radiation dose (up to 1.7×10^{20} eV/ml), dose rate, concentration of phenol (10^{-4} M to 0.9 M), and pH of the solution (pH 2 to 14). It was established that the $CH(OH)_2$ radical is of main importance for the carbonylation of phenol. An analytical method for the determination of salicylaldehyde was also worked out. (auth)

49829 STABILIZED FREE RADICALS IN THE RADIATION CHEMISTRY OF FROZEN AQUEOUS SYSTEMS. Ershov, B. G.; Pikaev, A. K. (Inst. of Physical Chemistry, Moscow). Radiat. Res. Rev., 2: 1-101(Aug. 1969).

A review is presented on the trapped electron, the hydrogen atom, OH and O^- radicals, spatial distribution of radicals in irradiated frozen aqueous solutions, the mechanism of low temperature radiolysis of water and aqueous solutions, and free radicals from solutes. It was concluded that ion processes play an important role during low temperature radiolysis of water and aqueous

solutions. This was also confirmed for glassy systems by stabilization of the electron in many such systems. Noticeable successes that have been attained in the radiation chemistry of frozen aqueous systems due to the efforts of many laboratories in the world are emphasized. (269 references). (P.C.H.)

49830 IONISING RADIATIONS AND ORGANOMETALLIC COMPOUNDS. Blackburn, R.; Kabi, A. (Univ. of Salford, Eng. Univ. of Nottingham, Eng.). Radiat. Res. Rev., 2: 103-30(Aug. 1969).

A review is presented on energy absorption in organometallics, basic radiolysis studies, studies in radiosynthesis, and scintillation and quenching studies. (163 references). (P.C.H.)

49831 EFFECT OF IONIZING RADIATION ON SOLID PROTEINS. Friedberg, Felix (Howard Univ., Washington, D. C.). Contract AT(30-1)-2735. Radiat. Res. Rev., 2: 131-47(Aug. 1969).

A review is presented on the following aspects of the problem: interpretation of free radical patterns detectable by ESR after exposure of the lyophilized protein to the γ ray; findings from free radical interception by scavengers for the purpose of investigating the secondary carbon free radical distributions generated by the γ ray in the lyophilized protein; major chemical effects of ionizing radiation on lyophilized proteins and observed in conventional studies of chemical changes (e.g., peptide bond scission) and of physicochemical changes. The goal is to establish a balance sheet of agreements and disagreements among observations that have resulted from different technical approaches. (47 references). (P.C.H.)

49832 APPLICATION OF THE REFINED MODEL OF NONHOMOGENEOUS KINETICS TO THE REACTIONS OF ELECTRONS DURING THE γ RADIOLYSIS OF ETHANOL AND 2-PROPANOL. ENERGIES AND ENTROPIES OF ACTIVATION OF THE REACTIONS OF SOLVATED ELECTRONS WITH ALCOHOLS AND WITH WATER. Jha, K. N.; Freeman, G. R. (Univ. of Alberta, Edmonton). J. Chem. Phys., 51: 2839-50(Oct. 1, 1969).

The yields of nitrogen and hydrogen from the radiolysis of solutions of nitrous oxide in ethanol and in 2-propanol at temperatures from about -100 to $+140$°C were calculated by the refined model of the nonhomogeneous kinetics of ionic reactions in irradiated alconols. The calculated yields agree satisfactorily with those measured experimentally. The value G(total ionization) = 4.3 was assumed for both liquids. In "absolutely pure" ethanol the values of $G(H_2)$ and $G(e^-_{solv})_{fi}$ were estimated to be, respectively, 5.3 and 1.7 at -112°C, 5.3 and 1.5 at +25°C, 6.3 and 1.4 at 90°C, and 6.9 and 1.2 at 145°C. For the decomposition of the solvated electron $e^-_{solv} \rightarrow RO^-_{solv} + H$ [Eq(8)] in ethanol at 25°C, $k_8 = 1 \times 10^5$ sec^{-1}, $E_8 \sim 4.6$ kcal/mole, and $\Delta S_8^{\ddagger} \sim -21$ cal/deg · mole. In "absolutely pure" 2-propanol the values of $G(H_2)$ and $G(e^-_{solv})_{fi}$ were estimated to be, respectively, 4.1 and 1.2 at -85°C, 4.9 and 1.3 at +25°C, and 5.4 and 1.0 at 140°C. For the decomposition of the solvated electron in 2-propanol at 25°, $k_8 = 3 \times 10^5$ sec^{-1}, $E_8 \sim 6.3$ kcal/mole, and $\Delta S_8^{\ddagger} \approx -14$ cal/deg · mole. In each of the liquids methanol, ethanol, 1-propanol, 2-propanol, and water. Reaction (8) has an activation energy approximately equal to that of dielectric relaxation, which is also approximately equal to that of diffusion. It is concluded that Reaction (8) is approximately thermoneutral and that the enthalpy of solvation of RO^- is more than 70 kcal/mole more negative (exothermic) than that of the electron in each of the five liquids. The activation energy E_8 might be used either to rearrange the solvent molecules about the reaction site or for the migration of the electron to a suitably oriented site. The large negative entropy of activation is related to the specific structure required by the transition state to increase the solvation energy of the negative species by more than 70 kcal/mole. (auth)

49833 THE CHEMICAL EFFECTS OF γ-RADIATION ON ORGANIC SYSTEMS. PART XIV. ACTION OF RADIATION ON NN-DIMETHYLANILINE AND OTHER AROMATIC TERTIARY AMINES. Fayadh, J. M.; Swan, G. A. (Univ. of Newcastle-upon-Tyne, Eng.). J. Chem. Soc., C, No. 13, 1775-80(1969).

Gamma radiolysis of pure N,N-dimethylaniline yielded N,N′-dimethyl-N,N′-diphenylethylenediamine (through dimerisation of the N-methylanilinomethyl radical) together with hydrogen, methane, and N-methylaniline; but when the radiolysis was carried out in the presence of acid the first named product was replaced by N-p-dimethylaminobenzyl-N-methylaniline and/or 4,4′-bisdimethylaminodiphenylmethane, formed via the ion $(PhNMe:CH_2)^+$ The two latter products were also formed by photolysis of the amine in the presence of acid. γ Radiolysis of N,N-dimethyl-p-toluidine gave N,N′-dimethyl-N,N′-di-p-tolylethylenediamine and 4,4′-bisdimethylaminobibenzyl. (auth) (UK)

49834 AUTORADIOLYSIS BY AUGER ELECTRONS AND SZILARD-CHALMERS REACTION. da Fonseca, A. J. R.; Fuller, K.; Latham, A.; Shaw, P. F. D. (Nuclear Physics Lab., Oxford). Radiochem. Radioanal. Lett., 2: 69-77(Oct. 13, 1969).

The distributions of the products from radiolysis and nuclear activation in bromoethane–bromine mixtures differ markedly and do not support the autoradiolysis hypothesis. (auth)

49835 RECOIL CHEMISTRY OF ^{32}P PRODUCED BY DIFFERENT NUCLEAR TRANSFORMATIONS IN SOME PHOSPHINE OXIDES, SULPHOXIDES, AND PHOSPHINE SULPHIDES. Venkateswarlu, K. S.; Jashnani, J. V. (Bhabha Atomic Research Centre, Bombay). Radiochim. Acta, 12: 117-18(Aug. 1969).

Observations of the distribution of ^{32}P in some organophosphorus and organosulfur compounds are reported in order to compare the results of (n,γ) and (n,p) reactions. The effects of γ irradiation and thermal annealing on the percentage retention of ^{32}P in different samples was considered and the mechanisms involved discussed. The presence of a phosphate or thiophosphate group proved to be effective in reintroducing ^{32}P into the molecule; however, if the functional group is P=O or S=O only, such reentry is not favored. (D.H.M.)

49836 EFFECT OF TEMPERATURE ON THE REACTIONS OF ELECTRONS DURING THE γ RADIOLYSIS OF LIQUID n-PROPANOL. Jha, K. N.; Freeman, G. R. (Univ. of Alberta, Edmonton). J. Chem. Phys., 51: 2839-46(Oct. 1, 1969).

Purified n-propanol was irradiated at temperatures from -120 to +264°C and $G(H_2)$ increased from 4.1 to 5.9 over this range. Solutions of electron scavengers (acid and nitrous oxide) were irradiated at -120, +25, and 140°C. The values of $G(H_2)$ for absolutely pure n-propanol were estimated to be 4.3 at -120°, 4.9 at 25°, and 6.0 at 140°. The value of G(total ionization) ≈ 4.3 estimated at -120° was assumed to be independent of temperature. The free-ion yield was $G(e^-_{solv})_{fi} = 1.1$ at -120°C, 1.2 at +25°C, and 0.8 at 140°C. A reaction mechanism was proposed and the measured hydrogen and nitrogen yields were subjected to kinetic analysis; homogeneous kinetics were used for the reactions of the free ions and nonhomogeneous kinetics were used for the reactions in spurs. The activation energy of dielectric relaxation (6.1 kcal/mole) is greater than that of diffusion (~4.5 kcal/mole); it was necessary to use a time-averaged value of the dielectric constant for the smaller ion–electron separation distances at -120°, but the static value was satisfactory elsewhere. The reaction $e^-_{solv} \rightarrow n\text{-}C_3H_7O^-_{solv} + H$ has a rate constant of about 5×10^5 sec^{-1} at 25°C and has an activation energy of 4.5 kcal/mole and an entropy of activation of -19 cal/deg · mole. Only a fraction of the electrons that undergo geminate neutralization lead to hydrogen formation; the value of the fraction is 0.29 at -120°C, 0.52 at +25°C, and 0.63 at 140°C. (auth)

49837 THE EFFECT OF NITRATE IONS ON THE γ-RADIOLYSIS OF AQUEOUS SOLUTIONS OF ETHANOL. Azim, M. A.; Majid, Hafiz Abdul (Government Coll., Lahore). J. Natur. Sci. Math., 9: No. 1, 17-23(Apr. 1969).

The oxidation of ethanol to acetaldehyde with nitrate ions proceeds principally through an intermediate species NO_3^{-2}, springing from the scavenging of radioproduced electrons by nitrate ions. NO_3^{-2} reacts with hydrogen ions to give NO_2 via reaction $H^+ + NO_3^{-2} \rightarrow NO_2 + OH^-$ which gives NO_2^- via reaction with water. ($2NO_2 + HO_2 \rightarrow NO_2^- + NO_3^- + 2H^+$). But in presence of organic free radicals CH_3CHOH, NO_3^{-2} yields NO_2^- and the organic product CH_3CHO via $CH_3CHOH + NO_3^{-2} \rightarrow CH_3CHO + NO_2^- + OH^-$. The interpretation of the results on this mechanistic pattern, conform to the yields of the primary products in the irradiated water. At 10^{-3} M to 5×10^{-3} M nitrate concentrations in 10^{-3} M ethanol, the yields of acetaldehyde and nitrite come to be, $G(CH_3CHO) \sim 2.4$ and $G(NO_2^-) \sim 2.50$. Similarly the yields of these products at nitrate concentrations above 5×10^{-3} M are, $G(CH_3CHO) \sim 2.2$ and $G(NO_2^-) \sim 2.78$, $G(H_2O_2)$ almost neither increases nor decreases in both cases, presumably due to the fact that molecular yields of hydrogen peroxide are not affected by any reaction. (auth)

49838 TRANSFER ANNEALING IN ALKALI IODATES. Bellido, A. V.; Wiles, D. R. (Carleton Univ., Ottawa). Radiochim. Acta, 12: 94-7(Aug. 1969).

A study was made of transfer annealing reactions in KIO_3 and $NaIO_3 \cdot H_2O$ doped with ^{131}I as iodide. The radioactive iodine was partly converted to iodate in a short time in both substrates, under the influence of heat and of gamma radiation. It was also found that a considerable fraction (up to 80% in some cases) of the radioactive ^{131}I was found to be volatilized as I_2. Both these phenomena are interpreted in terms of a stepwise reaction, constituted of successive electron transfer and oxygen ion transfer processes. It is noted that transfer annealing data must be viewed with caution when volatile intermediate products are possible. (auth)

49839 THE CHEMICAL EFFECTS OF γ-RADIATION ON ORGANIC SYSTEMS. PART XV. FORMATION OF QUINOLINE

DERIVATIVES BY THE RADIOLYSIS OR PHOTOLYSIS OF AROMATIC TERTIARY AMINES IN THE PRESENCE OF OLEFINS OR CONJUGATED OLEFINS. Fayadh, J. M.; Swan, G. A. (Univ. of Newcastle-upon-Tyne, Eng.). J. Chem. Soc., C, No. 13, 1781-4 (1969).

Gamma radiation or photolysis of N,N-dimethylaniline in the presence of N-phenylmaleimide yielded 1,2,3,4-tetrahydro-1-methylquinoline-3,4-N-phenyldicarboximide, through a radical reaction. A similar reaction occurred with other N,N-dialkylanilines, N-phenylpyrrolidine, or N-phenylpiperidine in the presence of olefinic compounds such as N-phenylmaleimide, diethyl maleate, cyclohexene, or cyclopentene. (auth) (UK)

49840 EFFECT OF IRRADIATION ON DIELECTRIC RELAXATION AND ELECTROCONDUCTIVITY IN POLYTRIFLUOROCHLORETHYLENE. Knizhnik, E. I.; Mamchich, S. D. Vysokomol. Soedin., Ser. A, 11: 1665-9(Aug. 1969). (In Russian).

The results of dielectric losses and electroconductivity in poly(chlorotrifluoroethylene) irradiated by doses 0 to 150 Mrad are given. The most probable relaxation time τ and activation energies of dipole-group (γ-process) and dipole-segmental (β-process) and tg δ_{max} for the dipole group losses were decreased with irradiation. Value of tg δ_{max} for dipole-segmental losses passed through a maximum. The specific volume resistance was considerably decreased with the dose, but showed a tendency to regain with time. The apparent activation energy of electroconductivity was increased with irradiation. (auth)

49841 PHYSICOMECHANICAL BEHAVIOR AND STRUCTURE OF IRRADIATED AND UNIRRADIATED COPOLYMERS OF ETHYLENE WITH VINYL CHLORIDE. Egorova, Z. S.; El'kina, A. I.; Duntov, F. I.; Karpov, V. L.; Leshchenko, S. S. Vysokomol. Soedin., Ser. A, 11: 1766-73(Aug. 1969). (In Russian).

Radiation effects on the physicomechanical behavior of ethylene–vinyl chloride copolymers (EVC) containing 15 to 77 mole % of vinyl chloride have been studied. Methylene groups had a plasticizing effect on the copolymer with high VC content. EVC with 15.6% VC has rubber-like properties. Radiation crosslinking was most effective at a VC content of 15.6 mole %. Tensile strength and heat resistance of the copolymers increase with the dose. The optimum behavior was observed at the dose below 100 Mrad. (auth)

49842 RADIATION-INDUCED GRAFT POLYMERIZATION OF METHYL METHACRYLATE AND CELLULOSE. Detrick, Carl A.; Kelly, James L. (Univ. of Virginia, Charlottesville). Nucl. Appl. Technol., 7: 472-7(Nov. 1969).

The quantitative effects on certain factors on the radioinduced graft polymerization of methyl methacrylate (MMA) and paper (cellulose) were determined. All irradiations were performed in a medium-intensity gamma radiation field created by neutron activation of ^{55}Mn. Resultant radiation dose rates varied between 1.4 and 3.2×10^5 rads per hour initially and diminished with a 2.58-hr half-life. Sample preparation was an important variable in that paper samples immersed in MMA and irradiated immediately thereafter exhibited no grafting, whereas samples soaked 4 and 24 hrs prior to irradiation yielded increasing amounts of grafting for the same radiation dose. Hydroquinone, which serves as an ideal inhibitor for bulk MMA, yielded no induction period at all for the MMA–cellulose system. The effects of oxygen on the graft polymerization of MMA were similar to its effects on the homopolymerization of MMA. The use of acetone as a solvent for MMA enhanced the amount of graft polymerization. Even higher yields per absorbed dose were obtained using a water–acetone–MMA solution. Furthermore, no pre-irradiation "soak" was necessary to achieve grafting at relatively low absorbed doses in the MMA–solvent systems. (auth)

49843 RADIATION GRAFTING OF VINYL CHLORIDE TO SKN-40. Usmanov, Kh. U.; Yul'chibaev, A. A.; Asamov, M. K. Nauch. Tr., Tashkent. Gos. Univ., No. 284, 123-6(1967). (In Russian).

Vinyl chloride (VC) was grafted to butadiene–acylonitrile rubber SKN-40 by ^{60}Co γ irradiation in an attempt to obtain graft copolymers of improved thermal and mechanical properties and to determine the effects of conditions on graft polymerization. Purified VC in cyclohexanone solution and SKN-40 in dichloroethane solution were irradiated in degassed and sealed ampullas at 15 to 330 R/second for 165 minutes to 18 hours. At constant intensity and dose, the amount of grafted VC increased proportionally to its concentration in the initial composition; its conversion remained constant and the amount of formed VC homopolymer increased simultaneously with grafting. The amount of homopolymer increased with intensity to 100 R/second, and it decreased with increase in intensity from 150 to 300 R/second. Polymer weight increased with dose and radiation time, but the amount of formed graft copolymer was little affected by the dose; its formation was controlled by the diffusion rate of monomer molecules to the polymer radicals. An increase in intensity at constant doses caused a decrease in the yield of graft copolymer because of the acceleration of termination reactions at high intensities. The properties of prepared graft polymers are not reported. (ATD)

49844 CHEMICAL STATES OF RADIO-ANTIMONY FORMED BY HIGH-ENERGY PROTON IRRADIATION OF CESIUM CHLORIDE. Dema, I. (Inst. of Atomic Physics, Bucharest); Zaitseva, Natalia G. J. Inorg. Nucl. Chem., 31: 3039-41(Oct. 1969).

The chemical states of radioantimony formed by proton irradiation of crystalline cesium chloride and cesium nitrate were determined. The yield of radioantimony recoils in higher oxidation state depends on the proton flux and the extent of thermal annealing. (auth) (UK)

49845 PREPARATION OF THIN ^{165}Tm SOURCES. Martinon, R.; Demeyer, A.; Marguier, G.; Chery, R. (Univ., Lyon). J. Inorg. Nucl. Chem., 31: 3019-21(Oct. 1969). (In French).

The preparation of carrier-free sources of ^{165}Tm for use in beta spectroscopy and studies of low-energy conversion electrons is proposed. Various technical problems are investigated and improvements suggested. (auth) (UK)

49846 EFFECTS OF ILLUMINATION ON THE RADIATION YIELD OF TRANSVERSE BONDS IN POLYBUTADIENE. Novikov, G. F.; Kozlov, V. T.; Yakovlev, B. S.; Frankevich, E. L. Izv. Akad. Nauk SSSR, Ser. Khim., No. 8, 1842-3(Aug. 1969). (In Russian).

A decrease in concentration of transverse bonds, as a result of illumination, was discovered in gamma-induced butadiene polymerization. A significant part (≥25%) of the transverse bonds at radiation doses of approximately 10 Mrad was formed in the post-irradiation processes with participation of ionized states. (tr-auth)

49847 MODIFICATION OF POLYVINYL CHLORIDE WITH SYNTHETIC RUBBER SKN-40. Usmanov, Kh. U.; Tillaev, R. S.; Kurbanov, Sh. A.; Bronovitskii, V. E. Nauch. Tr., Tashkent. Gos. Univ., No. 284, 107-11(1967). (In Russian).

Commercial poly(vinyl chloride) (PVC) was plasticized by blending with butadiene–acrylonitrile rubber SKN-40 and vulcanized by gamma irradiation from a cobalt-60 source or by pressing at 300 atmospheres and 145°C. The thermal and mechanical properties of the products were determined. PVC and SKN-40 were mixed in 80:20 to 40:60 ratios, neozon stabilizer and dyestuff were added, and the mixtures were cross linked after blending on rollers. Maximum mechanical strength of the artificial leather sheets was reached at the PVC:SKN-40 ratio of 80:20, and it increased from 116.2 to 196.8 kg/cm^2 after thermal vulcanization and to 133 kg/cm^2 after curing with a dose of 1 MR. Strength decreased when the dose was 2 MR. The glass transition point of the blends decreased linearly with increasing SKN-40 content, and deformation decreased after curing. Swelling increased and the viscosity of solutions decreased with increasing SKN-40 content. (ATD)

49848 RADIOSENSITIZATION BY N-ETHYL MALEIMIDE: A MODEL CHEMICAL SYSTEM. Ward, J. F.; Johansen, I.; Aasen, J. (Norwegian Defence Research Establishment, Kjeller). Int. J. Radiat. Biol., 15: 163-70(1969).

N-ethylmaleimide (NEM), a known cellular radiosensitizer, was studied from a radiation chemical viewpoint. It was found to react rapidly with free radicals from water. The NEM–OH radical adduct can react further with another NEM molecule in the absence of oxygen. NEM also reacts with radicals produced by the reactions of OH free radicals and hydrated electrons with nucleic acid components. These reactions occur in the absence of oxygen by both electron transfer and bond formation. NEM is able to compete with oxygen for free radicals produced by reaction of OH + thymine. These oxygen-like reactions of NEM may explain in part the mode of action of NEM as a radiosensitizer at the cellular level. (auth)

49849 REACTIONS OF IONS IN THE RADIOLYSIS OF LIQUID PROPANE. Tanno, Kuniyasu; Shida, Shoji (Tokyo Inst. of Tech.). Bull. Chem. Soc. Jap., 42: 2128-31(Aug. 1969).

The reactions of ions, especially fragmentation of excited ions and the subsequent reactions of fragment ions in the radiolysis of liquid propane, were investigated by the use of charge scavengers such as sulfur hexafluoride (SF_6) and ammonia (NH_3). It was confirmed that the fragment ions are produced by the dissociation of the excited parent ion prior to the parent ion-electron recombination. The yields of $C_2H_5^+$ and $C_3H_7^+$ were measured by the use of the reaction, $RH^+ + NH_3 \rightarrow R + NH_4^+$, with the results $G \geq 0.28$ and ~1.1 respectively. These ions neutralize with electrons to form ethylene or propylene. The hydride ion transfer reaction between $C_2H_5^+$ and propane may be competing with the neutralization of $C_2H_5^+$ by electron in the absence of an additive. The yields of fragment ions are compared in the radiolysis of several saturated hydrocarbons. (auth)

49850 THE MECHANISM OF THE SCINTILLATION FROM A BENZENE SOLUTION OF p-TERPHENYL. Saito, Tsunenari; Sato, Shin (Tokyo Inst. of Tech.). Bull. Chem. Soc. Jap., 42: 2228-32(Aug. 1969).

The luminescence from a benzene solution containing p-terphenyl induced by γ-ray irradiation was compared with that induced by uv irradiation at 2500 Å in the presence of various quenchers. The quenching efficiencies of electron and positive ion scavengers (SF_6, N_2O, CO_2, and NH_3) were found to be greater for the γ-ray excitation than for the uv excitation, while 1,3-butadiene, which is known as a quencher for excited benzene, ($^1B_{2u}$), showed almost the same efficiency for both modes of excitation. These results suggest that, even in a benzene solution, a series of ionic reactions is partly responsible for the formation of the scintillating state of p-terphenyl, and that the apparent quenching effect of ion scavengers is mainly due to their interference in the formation of the excited state of the benzene which is produced by the recombination reaction between the benzene cation and an electron. It was estimated that more than 30% of the excited state of benzene is formed by the recombination reaction. (auth)

49851 PULSE RADIOLYSIS WITH ELECTRIC CONDUCTIVITY. A METHOD OF OBTAINING THE RATES OF PROPAGATION IN THE RADIATION-INDUCED POLYMERIZATION OF α-METHYLSTYRENE. Katayama, Meiseki; Yamazaki, Hatsuo; Ozawa, Yasutomo (Hokkaido Univ., Sapporo). Bull. Chem. Soc. Jap., 42: 2410(Aug. 1969).

A method of obtaining the rates of propagation in the radioinduced polymerization of α-methylstyrene is presented that involves determining the mobilities of ions. From the data obtained and the fact that the polymerization proceeds much faster in a dry sample than in wet ones, it may be concluded that the anionic reaction is more important than the cationic one in the radioinduced polymerization of α-methylstyrene. (D.H.M.)

49852 ESR STUDY OF RADIOINDUCED GRAFT POLYMERIZATION OF METHYL METHACRYLATE ON FLAKY GLASS. Kanazawa, Yoshiko; Higashide, Fukuji (Shizuoka Pharmaceutical Coll., Japan). Kobunshi Kagaku, 26: 582-6(Aug. 1969). (In Japanese).

A study was made of the mechanism of graft-polymerization of methyl methacrylate (MMA) on γ-ray irradiated flaky aluminosilicate glass and the effect of the radioinduced defect in the glass on the graft polymerization using the pre-irradiation method. The characteristic six line ESR signal due to the radioinduced defect in the glass disappeared when MMA monomer was added at room temperature to the irradiated glass which was previously treated with $K_2Cr_2O_7-H_2SO_4$ solution. After a few hours a different signal composed of nine hyperfine components with a separation of 11.5 gauss began to appear, which is attributed to the growing radical of PMMA, $R-CH_2-\dot{C}(CH_3)(COOCH_3)$. The intensity of the nine line signal was observed to increase with time and reached to a maximum after 50 to 60 hours. The polymer radical was very stable and has survived keeping its maximum concentration even after five months or longer. The presence of graft polymer was confirmed by ir spectrum. A possible mechanism is that the defect of electron center is extinguished by interaction with an intruded MMA molecule. But, as it is in some transition state no radical is formed immediately and then the monomer radical is produced slowly keeping its coordination at the aluminum site. The subsequent polymerization of MMA proceeds by a radical mechanism. As the radical is located at one end of each chain attached to the glass, at another end the termination reaction hardly takes place due to diffusion effect. (NSA of Japan)

49853 RADIATION GRAFTING OF VINYL ACETATE TO BUTYL RUBBER. Usmanov, Kh. U.; Tillaev, R. S.; Khalikov, T. Nauch. Tr., Tashkent Gos. Univ., No. 284, 102-6(1967). (In Russian).

Graft polymerization of vinyl acetate (VA) to butyl rubber (BR) under gamma irradiation from a cobalt-60 source was studied to determine the effects of 1 to 10 Mrad doses on the amount of formed graft polymer and its properties. Acetone-extracted BR and freshly distilled VA were irradiated at 50 R/sec intensities in evacuated and sealed ampuls and also in air, and were extracted with acetone and subsequently with ligroin to remove the unreacted BR. The content of grafted polyvinyl acetate in the product, determined by the concentration of acetate groups, remained constant at 1:1 BR:VA ratios at doses to 3 MR and increased at higher doses. The yield of grafted copolymer reached a maximum at 2 MR. Swelling in acetone increased and swelling in heptane decreased with increasing VA content in agreement with published data. Measurements of the thermal-mechanical properties of the products at −80 to 90°C showed a decrease of the temperature interval of the elastic state of the product with increase of graft polymerization. (ATD)

49854 METHOD FOR PRODUCING NEW TERNARY COPOLYMERS. Fukui, Kenichi (to Sumitomo Chemical Co.). Japanese Patent 1969-11659. May 28, 1969. Filed Mar. 27, 1965.

By the method proposed, a variety of ternary copolymers of ethyleneimines, carbon monoxide, and low-grade olefins are obtained easily; the products having amide bonds can be used for various purposes such as fibers, plastics, etc. The method consists of irradiating a mixture of the three monomers mentioned. By selecting different kinds of the ethyleneimines and the low-grade olefins, a variety of the ternary copolymers are obtained. The ethyleneimines include ethyleneimine, propyleneimine, etc.; while, the low-grade olefines may be ethylene, propylene, etc. The ionizing radiation may be x-ray, electron beam, alpha ray, etc. Ratios of the three monomers can be any value from 0.1 to 99.9 mole %, respectively; temperature is −78 to 200°C, and pressure is from ordinary pressure to 2000 atm. (NSA of Japan)

49855 SYNTHETIC SPECTROSCOPIC MODELS RELATED TO COENZYMES AND BASE PAIRS. III. A 1,1'-TRIMETHYLENE-LINKED THYMINE PHOTODIMER OF CIS-SYN STRUCTURE. Leonard, Nelson J.; Golankiewicz, K.; McCredie, Robert S.; Johnson, Suzanne M.; Paul, Iain C. (Univ. of Illinois, Urbana). J. Amer. Chem. Soc., 91: 5855-62(Oct. 8, 1969).

1,1'-Trimethylenebisthymine, Th−C_3−Th, rapidly undergoes photoreaction when irradiated at 300 nm in dilute aqueous solution to form an intramolecular dimer. The shortness of the trimethylene bridge connecting the 1- and 1'-nitrogens of the thymine moieties precludes an anti structure and permits only cis-syn or trans-syn geometry. The conversion of the internal photodimer to a product having an additional o-xylylene bridge between the 3- and 3'-nitrogens excluded the trans-syn possibility. X-ray study reveals that the crystals of the internal photodimer of 1,1'-trimethylenebisthymine are monoclinic, space group $P2_1/c$, with a = 9.04 Å, b = 17.70 Å, c = 12.48 Å, and β = 138° 30', and there are four molecules in the cell. The structure was refined to an R factor of 0.046 on 1823 structure amplitudes collected on a diffractometer. The cis-syn stereochemistry was established for the photodimer. The virtual planarity of the cyclobutane ring results in almost complete overlap of the projections of the thymine rings in the dimer. About 10% of the molecules exist in the monomeric form after prolonged X irradiation. The complete structural analysis of crystalline $\overset{\frown}{Th-C_3-Th}$ is of special interest because of its relationship, in cis-syn stereochemistry, with the major thymine photoproduct from native DNA. (auth)

49856 PULSE RADIOLYSIS OF AQUEOUS SOLUTIONS. SOME RATES OF REACTION OF OH AND O^- AND pH DEPENDENCE OF THE YIELD OF O_3^-. Buxton, G. V. (Univ. of Leeds, Eng.). Trans. Faraday Soc., 65: 2150-8(Aug. 1969).

Rate constants of the reactions of OH and O^- with NO_2^-, HCO_2^-, I^-, H_2O_2 and HO_2^- were measured using the carbonate competition method at pH 11 and 13. The results are consistent with the rapid establishment of the equilibrium $OH + OH^- \rightleftharpoons O^- + H_2O$. The pH dependence of the yield of O_3^- in oxygenated alkaline solution is consistent with the rapid establishment of an acid-base equilibrium, pK = 10.4, which is probably $HO_3 + OH^- \rightleftharpoons O_3^- + H_2O$. (auth) (UK)

49857 BASIC PRINCIPLES OF RADIATION CHEMISTRY. Drawe, H. (Kernforschungsanlage, Juelich, Ger.). Atompraxis, 15: 249-53(July-Aug. 1969). (In German).

Today radiochemical processes find application in biology, medicine, technical and preparative chemistry, thus quantitative treatment of radiation-chemical reactions is of great importance. The most important conceptions of radiation chemistry and the methods of calculation in radiolytic processes are reviewed. Examples serve to explain the calculations. (auth)

49858 RADIOLYSIS OF PHENYLALANINE AND TYROSINE IN AQUEOUS SOLUTION. Wheeler, Owen H.; Montalvo, Rafael (Puerto Rico Nuclear Center, Mayaguez). Radiat. Res., 40: 1-10(Oct. 1969).

The radiolysis of phenylalanine, tyrosine, and DOPA (dihydroxyphenylalanine) in water, of phenylalanine and tyrosine in 0.5 N hydrochloric acid and of phenylalanine in 0.5 N sulfuric acid were studied using ^{14}C labeled compounds. Phenylalanine formed tyrosine, tyramine, DOPA, and phenylpyruvic acid, while tyrosine afforded DOPA, DOPAMINE and p-hydroxyphenylpyruvic acid. The final product in all cases was an insoluble polymer. A linear relation was found between log G_{-M} and the absorbed dose, and the relative rate constants for radiolysis were obtained. (auth)

49859 A STUDY OF TRAPPED CHARGE CARRIERS IN GAMMA-IRRADIATED ORGANIC POLYMERS. Barnes, James Edward. Lawrence, Kan., Univ. of Kansas, 1968. 149p. Thesis.

The trapping and detrapping of radioinduced charge carriers in certain organic polymers was studied, especially in poly(methyl methacrylate) (PMMA) and poly(vinyl chloride) (PVC). Thermoelectric currents were generated in the polymers after irradiation by thermally stimulating the release of the trapped charge carriers and moving them through the material under the influence of a temperature gradient. The temperature gradient was generated by heating disk shaped polymer samples unsymmetrically in an oven. Heating similarly irradiated samples in the absence of a temperature gradient produced a 10-fold reduction in the observed current. Currents generated in this manner were correlated to the presence of selected additives, the heating rate (or temperature gradient), and the period of storage of the samples at different temperatures between irradiation and measurement. The sign of the mobile charge carrier was determined to be positive, from the observation of the polarity of charge movement in a temperature gradient. It is, however, the electrons liberated during irradiation which must be trapped to prevent recombination. This trapping is not done by the polymer matrix in PMMA at 25°C but by added impurities. PVC contains a built-up trap in the polymer chain at the C–Cl group. The electron trap in commercial Lucite is the chemical initiator benzoyl peroxide or another similar peroxide. Electron traps are also internally generated in the pure PMMA polymer by the action of radiation. This is a result of main chain scission and side chain dissociation which create several possible trapping sites. The temperature at which maximum charge conduction in a temperature gradient occurs, and thus the temperature of charge carrier release, was correlated to the onset of internal motion in the carbomethoxy side group of the polymer. The stability of the trapped charge carriers was related to the activation energy. The trapped charge carriers in PVC were very stable as indicated by their activation energy of 67 kcal/mole compared to a value of 18.6 kcal/mole for Lucite. An electric field was applied to samples of various irradiated polymers while the samples were being heated in the absence of a temperature gradient. The current peak generated in this manner occurred at a much higher temperature than the temperature at which the peak thermoelectric current occurred. It was also demonstrated to be independent of the radioinduced thermoelectric current. Several polymers were found that produced a radioinduced current in the presence of an electric field but not in a temperature gradient. The results showed that a temperature gradient can be used effectively to generate thermoelectric currents for the study of radioinduced charge trapping in organic polymers. (Disser. Abstr.)

49860 METHOD FOR GAS-CHROMATOGRAPHIC ANALYSIS OF SMALL AMOUNTS OF RADIOLYSIS PRODUCTS DISSOLVED IN THE LIQUID PARENT. **Castello, Gianrico; Munari, Stelio (Univ., Genoa). Ric. Sci., 39: 45-52(Jan. 1969).**

A device is described which allows the complete analysis of gaseous and liquid products obtained from radiolysis of liquid hydrocarbons. Cooling of liquid samples to appropriate temperature before gas extraction and the dilution of extracted gases with an excess of carrier gas gave the following advantages: sampling at appropriate pressure, greater number of analyses from a small volume of products, no condensation of heavy products, easy analysis of samples containing hydrogen. The gas-chromatographic analysis was accomplished by means of thermal-conductivity and flame-ionization detectors connected in series. The system described is useful for analysis of any type of gases dissolved in liquid media. (auth)

49861 FRACTIONATION OF POLY(ISOBUTYLENE)–POLY(STYRENE) COPOLYMERS PREPARED BY RADIOCHEMICAL MEANS: COMPARISON BETWEEN FRACTIONAL ELUTION ON A COLUMN WITH THERMAL GRADIENT AND FRACTIONAL PRECIPITATION. **Danon, J.; Jozefonvicz, J. (Faculte des Sciences, Orsay, France). Eur. Polym. J., 5: 405-17(June 1969). (In French).**

Fractionation by the thermal-gradient elution-fractionation method (TGEF) of radioinduced poly(styrene)–poly(isobutylene) copolymers is described. Optimal conditions for fractionation efficiency were sought. The influence of copolymer weight to be fractionated, elution rate, and column length were examined. Results with TGEF were compared with those obtained by fractional precipitation (FP). The two methods led to the same results when the sensitivity to the chemical composition of the solvent–nonsolvent system was temperature independent (benzene–isopropanol). They led to different results (TGEF fractionation is more sensitive to chemical composition than FP fractionation) when the sensitivity to chemical composition of the solvent–nonsolvent system decreased with rising temperature (cyclohexane–isopropanol). This difference resulted from the use of thermal gradient in TGEF (the top of the column is at a higher temperature than the bottom). (BBB)

49862 THE COMPLETE ANALYSIS OF GAS PHASE PHOTOLYSIS AND RADIOLYSIS PRODUCT MIXTURES BY GAS CHROMATOGRAPHY. **Heckel, Edgar; Hanrahan, Robert J. (Univ. of Florida, Gainesville). Contract AT(40-1)-3106. J. Chromatogr. Sci., 7: 418-24(July 1969).**

A Duplex Gas Chromatograph was built to give complete analysis of products from gas phase photolysis and radiolysis reactions of simple organic compounds. Products which can be analyzed include permanent gases (H_2, CH_4, N_2), less volatile components with boiling points up to 250°C, and inorganic or other components amenable to external analysis by spectrophotometry and titration. The unit consists of 2 separate gas chromatographs and a common vacuum inlet system, which includes a removable aliquot tube for external sample analysis, 2 sample loops, and an automatic Toepler pump. The pump collects permanent gases in 1 sample loop for analysis in an isothermal chromatograph with a thermal conductivity detector, while less volatile components are trapped in a second sample loop for analysis in a temperature-programmed chromatograph with a hydrogen flame ionization detector. To permit peak identification, the apparatus is equipped with a stream splitting valve to divert a portion of the sample into a mass spectrometer. Examples are given to illustrate use of the apparatus. (BBB)

49863 GAS CHROMATOGRAPHIC ESTIMATION OF LIQUID PRODUCTS OF THE RADIOLYSIS OF SOLID MALONIC AND SUCCINIC ACIDS. **Lukac, S.; Bartonicek, B. (Inst. of Nuclear Research, Rez, Czech.). Chromatographia, 2: 192-6(1969).**

The products of ^{60}Co γ radiolysis of malonic and succinic acids (CO_2 and the corresponding lower fatty acid, i.e., acetic and propionic acid, respectively) were studied. The gas chromatographic separation of water, and acetic and propionic acids was examined on several columns. At the beginning of the gas chromatographic analyses the fatty acids were converted to their corresponding esters and separation of these esters was carried out. The possibility of the direct analysis of free fatty acids was simultaneously investigated. The first attempt to solve this problem was by the examination of the same stationary phases (polyesters, polyglycols) for esters as well as for free acids. However, it was necessary to insure that the packing surface was uniform and thus the adsorption of free acids on the support suppressed. The use of glass beads as a uniform support was not successful because of the very limited amount of stationary phase to be coated; so, deactivation of the usual chromatographic supports was investigated. For routine analyses the best conditions were observed on a column containing 10% Emulphor-0 and 10% isophthalic acid on Chromosorb W, HMDS treated. For the quantitative estimation of propionic acid formed during the radiolysis of succinic acid, the minimum concentration of the product was 5×10^{-8} mole. (BBB)

49864 RADIATION CHEMISTRY OF BENZENE. **Lifshitz, Chava; Reuben, B. G. (Hebrew Univ., Jerusalem). Israel J. Chem., 7: 149-52(Jan.-Feb. 1969).**

The radiolysis of benzene in the gas phase with 25.6-eV electrons at a pressure of 3×10^{-4} mm Hg and subsequent analysis of the product ions was studied. The $C_6H_6^+$ ions do not react with benzene molecules. Collision of $C_6H_5^+$ and $C_6H_4^+$ with C_6H_6 eventually produce $C_{12}H_{10}^+$ and $C_{12}H_{11}^+$, with relatively long life times ($>10^{-5}$ sec) and can furthermore be pressure stabilized. Probably $C_{12}H_{10}^+$ is identical with the biphenyl ion. H_2 would be accounted for by its consumption in hydrogenation reactions. Higher polycyclic compounds are probably formed by reactions of cyclohexadienyl and biphenyl ions with benzene. For the reactions $C_6H_6 + e \rightarrow C_6H_5^+ + H + 2e$, and $C_6H_6 + e \rightarrow C_6H_4^+ + H_2 + 2e$, k_D/k_H = 0.60 and 0.53 respectively. For the condensation reactions $k_D/k_H \cong 1.4$, while for all reactions involving the production of H or H_2, $k_D/k_H = 0.6 - 0.9$. (BBB)

49865 EFFECT OF γ RADIATION ON SYNTHETIC FIBERS. II. IRRADIATION IN THE PRESENCE OF CHEMICALS. **Potnis, S. P.; Shetty, S. M.; Prakash, Jai (Univ. of Bombay). Angew. Makromol. Chem., 7: 85-100(June 30, 1969).**

Polyester and polyamide yarns were irradiated under controlled doses up to 5 Mrad of ^{60}Co γ rays in presence of gaseous ammonia and chloride and lead acetate, and also with methyl methacrylate, vinyl acetate, and acrylonitrile monomers. The irradiated monomers were tested for some physicochemical and mechanical properties. Some improvements were obtained in various desirable properties when irradiation was carried out in the presence of the chemicals employed. More ammonia was taken up by polyamide as compared to polyester under similar experimental conditions, probably due to the lower resistance of polyamide to γ rays, whereby more free radicals can be formed, as compared to the polyester having aromatic rings. The higher percentage of chlorine uptake seen with the polyester yarns may have been due to the presence of aromatic unsaturation which is more amenable

to chlorine attack. The extent of reaction with lead acetate solution, methylmethacrylate, vinyl acetate, and acrylonitrile monomer was less with the polyester. Again, this could be due to its aromaticity, which might absorb some of the γ energy and reduce the rate of grafting. Irradiation of both the polymers in the presence of ammonia gas resulted in increased melting points. The melting point of polyamide was increased considerably in the presence of methylmethacrylate and acrylonitrile monomers, probably due to an increase in the secondary bonds of the polar groups of the grafted monomer as well as an increase in molecular weight. The improved mechanical strengths observed at low doses (up to 0.5 Mrad) for polyester in ammonia as compared to unirradiated samples was assigned to crosslinking. Subsequent loss of strength showed degradation of the polymer in spite of the increase in percentage grafting. Both polymers showed poor strength when irradiated in the presence of chlorine, possibly due to the chain degradation followed by addition of chlorine to the broken ends of the polymer chain. Polyamide yarn showed much lower strength when irradiated in the presence of the chemicals, and a corresponding decrease in relative viscosity. Dye uptake of both polyamide and polyester yarns increased considerably after irradiation in the presence of chemicals, particularly the monomers. (BBB)

49866 RADIATSIONNAYA KHIMIYA I KABEL'NAYA TEKHNIKA. (Radiation Chemistry and Cable Engineering). Finkel, E. E.; Leshchenko, S. S.; Braginskii, R. P. Moscow, Atomizdat, 1968. 312p.

The scientific and technical principles of radiation modification of electrically insulating polymer materials are discussed. The physicochemical bases of the application of ionizing radiation for modification of the properties of polymers were examined. The mechanisms of radiation-chemical reactions, changes in the chemical structure of polymers on irradiation, the effects of irradiation conditions, and the effects of phase state, structural peculiarities, and additives were studied. The characteristics of radiation-modified materials for specific uses are discussed. The radiation stability of the polymers was also investigated. (tr-auth)

49867 RAPID SEPARATION OF CARRIERFREE Eu FROM MACROAMOUNTS OF Gd. Ross, R. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Isotopenpraxis, 5: 233(June 1969). (In German).

Carrier-free ^{159}Eu was produced by irradiation of ^{160}Gd in a betatron and rapid separation of the europium using a Li amalgam. (M.C.G.)

49868 PHOTOREACTION BETWEEN 8-METHYLPSORALEN AND DNA INDUCED BY GAMMA RAYS. Bordin, Franco; Busulini, Loris; Bevilacqua, Rita (Univ., Padua). Ric. Sci., 39: 53-60(Jan. 1969). (In Italian).

The uv radiation produced by the action of γ-rays on a toluene solution of p-terphenyl has been used as a source for the well-known photoreaction between 8-methylpsoralen and DNA. An intensity of 0.3×10^{13} quanta/s cm^2 was obtained and the photoreaction observed under these conditions was the same as that found using Hg 365 nm radiation. (auth)

49869 INSTRUMENTAL METHOD OF EVALUATION OF RADIOLYTIC DEGRADATION OF SOME ORGANOBORON COMPOUNDS. Giorgini, Marilena; Lucchesi, Aldo; Masetti, Giorgio; Santini, Paolo (Univ., Pisa, Italy). Ann. Chim. (Rome), 58: 1446-64(Dec. 1968). (In Italian).

Analytical methods for determining the degree of decomposition of the nuclear reactor coolants pyrocatechol phenylborate and phenylboronic anhydride on radiolysis are described; uniformity of results of different analytical techniques applied to samples irradiated in reactors (RST-1 G. Galileo, S. Piero a Grado; RC-1 Triga, Casaccia) is demonstrated. The ester (mixed with biphenyl) was decomposed to soluble and insoluble fractions; the amount of residue was established independently by gas chromatographic and ir analysis, and insoluble products were analyzed for β by emission spectrometry. The ir absorption band at 1237 cm^{-1} was used to establish concentration curves for determination of ester in biphenyl in ranges between 0.25% and 4.5%. The anhydride was irradiated in the pure state, and analysis was performed by ir analysis, using bands at 1440 cm^{-1}, 1365 cm^{-1}, 1348 cm^{-1}, and 1309 cm^{-1}; gas chromatographic analysis was impossible in this case because of pyrolysis. (BBB)

49870 FREE RADICAL DESTRUCTION BY GAMMA-IRRADIATION AT 77°K. Horan, Paul Karl; Snipes, Wallace (Pennsylvania State Univ., University Park). Int. J. Radiat. Biol., 15: 157-61(1969).

The destruction of free radicals by gamma-irradiation at 77°K was measured by electron spin resonance spectroscopy. The destruction process is apparently first-order with respect to radiation dose. Values of the rate constant for destruction of radicals in several compounds are: DL-valine, 0.14 (MR)$^{-1}$; N-acetyl-DL-valine, 0.07 (MR)$^{-1}$; L-threonine, 0.09 (MR)$^{-1}$; and dihydrothymine, 0.07 (MR)$^{-1}$. Possible mechanisms for this extremely efficient process are discussed. (auth)

49871 HOT-ATOM CHEMISTRY OF BROMINE. II. APPLICATION OF THE SZILARD–CHALMERS PROCESS TO ORGANIC MOLECULAR COMPOUND–PYRENEBROMANIL AND RELATED COMPOUNDS. Shinomiya, Chiro; Oyoshi, Akira; Kishikawa, Toshiaki (Kumamoto Univ., Japan). Bull. Chem. Soc. Jap., 42: 2356-9(Aug. 1969).

The chemical effects of the recoil bromine atoms in pyrenebromanil, a sandwich-type structure, was studied and compared to those of related compounds, bromanil, bromopyrene, and a pryene–bromanil mixture. The relationship between the percentage of ^{82}Br atoms remaining in the original layers and the irradiation time was studied. The extraction curves vary over a short period of radiation (1 to 10 min) but the curves seem to show no remarkable change with an increase in the irradiation time. The distribution of the ^{82}Br-labeled recoil products among the irradiated samples distributed in the aqueous layers at various irradiation periods is tabulated. The major portion of the activities was found in the form of bromide. (D.H.M.)

49872 GAMMA–RADIATION INDUCED CHLORINATION OF BENZENE. Sweet, John Philip. Minneapolis, Univ. of Minnesota, 1968. 208p.

Thesis.

Homogeneous solutions of chlorine in liquid benzene were irradiated with ^{137}Cs gamma radiation in a continuous stirred tank reactor in the presence of a low level of oxygen. The variables studied were outlet chlorine concentration (0.01 M to 1 M), reactor residence time (1.3 to 14 minutes) and exposure dose rate (37,600 to 313,000 r/hr). The reaction was carried out at ambient pressure and over a steady-state temperature range of 24 to 33°C. The overall reaction rate at steady-state, determined by measuring molecular chlorine consumption, was found to be $R_{Cl_2} = \Delta(Cl_2)/\theta = K_1 (Cl_2)_s I_{ABS}\, \theta/K_2 + \theta$ where $K_1 = (1.7 \pm 0.8)\ 10^{-11}$ ml/ev; $K_2 = 2.4 \pm 1.6$ min; $(Cl_2)_s$ = steady-state outlet chlorine concentration; I_{ABS} = rate of energy absorption (ev/ml-min); θ = reactor residence time (min). Values of G(Product) of the order of 10^4 molecules/100 ev indicate a chain reaction. The probable mechanism indicated by the results is a straight chain addition of chlorine to benzene with chlorine atoms as the centers of chain activity, the rate of initiation being proportional to the chlorine concentration and rate of energy absorption. The recombination of chlorine atoms appears to be a significant termination step only during the transient phase of the reaction. The slowly developing transients which are observed, and the steady-state residence time and dose rate dependence appear to be due to a termination mechanism involving the reaction of chlorine atoms with oxygen to form $ClO_2 \cdot$ radicals. Subsequent reactions of $ClO_2 \cdot$ would involve an unidentified radiolysis product of benzene, ϕ', resulting in a slow regeneration of chlorine atoms. An axial dispersion model, utilizing measured diffusivities, was used to calculate a time constant for the reactor outlet transient. The time constants so determined were found to be proportional to the 1.55 power of $1/I_{ABS}$. No residence time dependence was noted except for a possible residence time effect for the lowest dose rate and residence times. (Disser. Abstr.)

49873 RADIATION CHEMISTRY OF GAS-PHASE CARBON TETRACHLORIDE–CARBON TETRAFLUORIDE MIXTURES. Marcotte, Ronald Edward. Gainesville, Fla., Univ. of Florida, 1968. 113p.

Thesis.

The ^{60}Co γ radiolysis of samples ranging from pure CCl_4 to pure CF_4 was studied in the gas phase at 920 mm and 85°C. The yields of the major products formed in equimolar mixtures were as follows: $G(CF_3Cl) = 0.65$, $G(CFCl_3) = 1.05$, $G(CF_2Cl_2) = 0.077$, $G(C_2Cl_6) = 0.17$ and $G(C_2Cl_4) = 0.14$. Their rates of production were found to be independent of total dose in the range of doses studied (0.8×10^{18} to 8×10^{18} eV/ml). The following yields of minor products were found: $G(Cl_2) = 0.03$, $G(C_2F_6) = 0.006$, $G(C_2F_5Cl) = 0.003$, $G(C_2F_4Cl_2) = 0.001$ and $G(C_2F_3Cl_3) = 0.001$. When 4% oxygen was added to an equimolar mixture, the G values of all the major products were reduced by at least 90%. Product yields were also studied as a function of mixture composition. The yields of the minor products, including Cl_2, remained negligibly small, but the yields of CF_3Cl, $CFCl_3$ and CF_2Cl_2 were strongly peaked around 6 mol % CCl_4 with G values of 2.2, 6.9 and 0.62 respectively. The values of $G(C_2Cl_4)$ and $G(C_2Cl_6)$ reached maximum values of 0.24 and 0.38 respectively in pure CCl_4 and gradually decreased to zero as the concentration of CF_4 in the mixtures was increased. A

series of fast flow microwave discharge experiments were done as an aid in interpreting the mechanism of the radiolysis. From the study of CCl_4-CF_4 mixtures as a function of reaction time and composition, evidence was found for two possible reactive intermediates, ClF and C_2F_4. In a second series of experiments only one reactant passed through the discharge and the other reactant was added undissociated downstream. These experiments substantiated certain steps in the proposed mechanism and suggested the possibility of forming $CFCl_3$ by the reaction of CF_4 with a hot CCl_3 radical. (Disser. Abstr.)

49874 ELECTRON SPIN RESONANCE STUDY OF γ-IRRADIATED MORPHOLINIUM HEXAFLUOROPHOSPHATE. Alekov, Anna; Kelly, Penelope; Wan, J. K. S. (Queen's Univ., Kingston, Ont.). Spectrosc. Lett., 2: 91-5(Apr. 1969).

Morpholinium hexafluorophosphate samples, recrystallized from H_2O or D_2O, were placed in sealed quartz tubing and irradiated at 77°K in a 20,000-Ci source (^{60}Co). The dose rate was 1 Mrad/hr; the total dose was 0.5 to 2 Mrad. A typical ESR spectrum of the salt is illustrated. The spectra of the irradiated deuterated salt and the ordinary irradiated salt are identical. Available spectral parameters for PF^+ eliminate this species as the radical. The radical site is not at the N, nor at the C α to N. The spectrum was analyzed in terms of a nonplanar heterocyclic alkyl radical ion. It is not understood why γ irradiation of the morpholinium salt causes a C–H split at the β carbon as compared to the N–H split for NH_4^+ and C–C split in tetraalkylammonium halides. (BBB)

49875 RADIOLYSIS OF AQUEOUS BENZENE SOLUTIONS. Loblaw, James Calvin. Minneapolis, Univ. of Minnesota, 1968. 163p.

Thesis.

The γ-induced oxidation of benzene to phenol in aqueous solutions was investigated under a wide variety of conditions in both batch and tubular reactors. The study was concerned primarily with oxygenated solutions, deaerated solutions being considered only with the depletion of oxygen in the system. Temperatures to 261.5°C, pressures to 1300 psig, absorbed radiation doses to 5 Mrad, and variations in radiation dose rate, isotope photon energy, reaction solution volume to reactor wall surface area ratio, and post-irradiation storage times and temperatures were considered in some detail. Results indicate a linear absorbed radiation dose dependence and approximately exponential temperature dependence of phenol yield in the aqueous solution oxidation. Phenol G-values to 13.2 were found at high temperatures. No measurable wall, intensity, pressure, or energy effects were observed. Only slight variation in yield as a result of a post-irradiation effect was detected in solutions; in two phase, benzene-aqueous solution, mixtures an increase in yield of 13.5% was measured with storage at high temperature. Exploratory investigations of two phase mixtures and metallic oxide and salt catalysts were conducted. Increased phenol yield, 8 to 160%, which appears to depend on benzene–aqueous solution contact area was observed. A number of salts and oxides was considered. With the exception of previously uninvestigated titanium sulfate, for which a G-value of 3.71 was found, the results indicated no catalytic effect or were similar to those reported in the literature. (Disser. Abstr.)

49876 PULSE RADIOLYTIC MEASUREMENTS OF THE RATE CONSTANTS FOR THE COMBINATION OF POLY(ETHYLENE OXIDE) RADICALS IN AQUEOUS SOLUTIONS. Borgwardt, U.; Schnabel, W.; Henglein, A. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Makromol. Chem., 127: 176-84(Sept. 17, 1969). (In German).

OH radicals from the radiolysis of water attacked dissolved polyethylene oxide to yield side-group macroradicals. The uv absorption of these radicals was investigated. The rate constant of combination of two macroradicals could be calculated from the measured decay of the absorption after a short pulse of radiation. The rate constant determined for polyethylene oxide of various degrees of polymerization (2 to 3000) decreased with increasing chain length. The results were compared with the theories of others, in which the termination step of polymerizations was investigated as function of the chain length of the macroradicals. (auth)

Radiochemistry

Refer also to abstracts 49793 and 49834.

49877 (UCRL-18667) NUCLEAR CHEMISTRY DIVISION ANNUAL REPORT, 1968. Edelstein, Norman; Hendry, David; Michel, Maynard (California Univ., Berkeley. Lawrence Radiation Lab.). Jan. 1969. Contract W-7405-eng-48. 415p. Dep. CFSTI.

Progress on nuclear chemistry research is reported in 13 sections. Abstracts were prepared for 11 sections. Information in the two sections for which no abstracts appear includes articles on atomic and molecular spectroscopy and hyperfine interactions. (J.C.W.)

For abstracts of individual sections see: 49770–49772, 49819, 49996, 50120, 50211, 52120, 52143, 52144, and 52172.

49878 CURRENT TRENDS IN LABELED COMPOUNDS. Rothchild, Seymour (New England Nuclear Corp., Boston). Isotop. Radiat. Technol., 7: 68-75(Fall 1969).

The use of isotopically labeled compounds has grown continuously during the past 20 years. A large number of labeled chemicals have become available from commercial sources. Some of the more recent developments in labeled compounds, including tritium labeling, the biosynthetic method of preparation, labeled peptide synthesis, the application of chromatographic methods, and the problem of self-radiolysis, are discussed. (77 references). (auth)

Separation Processes

Refer also to abstracts 49721, 49727, 49772, 49990, 49996, 50001, 50002, 50037, 50069, 50079, 50089, 50575, 51010, and 51040.

49879 (BNWL-1051(Pt.2), pp 18-20) RADIONUCLIDE COLLECTION EFFICIENCIES FROM OCEAN WATER WITH ALUMINA. Silker, W. B.; Rieck, H. G. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The efficiency with which alumina removes radionuclides from seawater was determined in the laboratory and with in-situ measurements at sea. Good agreement between these two methods was obtained for most radionuclides. Disagreement in values for ^{51}Cr and ^{54}Mn are ascribed to existence of different chemical or physical forms in the two systems. (auth)

49880 (BNWL-1051(Pt.2), pp 21-3) ^{51}Cr(VI) SEPARATION FROM SEAWATER AND FRESH WATER ON A REDUCTION SORPTION BED. Perkins, R. W. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

A procedure was developed for the separation of ^{51}Cr from seawater and freshwater that involves passing the water through a 0.7 cm thick bed of $SnCl_2$-impregnated Al_2O_3. At linear flow rates of 75 cm per minute, the retention is greater than 99%. The ^{51}Cr content is determined by direct counting of the sorption bed in a large NaI(Tl) well crystal. By use of this technique in conjunction with the standard 600 cm^2 ocean sampling bed, ^{51}Cr concentrations of 0.02 dpm/liter can be measured by sampling 4000 liters of seawater. (auth)

49881 (CEA-CONF-1358) REPROCESSING OF SLIGHTLY ENRICHED URANIUM OXIDES: FRENCH CONTRIBUTION TO THE JAPANESE PROJECT. Lefort, Guy (Commissariat a l'Energie Atomique, [Paris] (France)). [1969]. 23p. (In French). (CONF-690535-4). Dep. CFSTI (U. S. Sales Only).

From IAEA Panel on Reprocessing of Highly Irradiated Fuels, Vienna, Austria.

By relying on Saint-Gobain Techniques Nouvelles for study of a plant for reprocessing in several steps, able especially to reprocess oxides of enriched uranium, The Atomic Fuel Corporation asked what was accomplished in the active tests in order to verify the performance in the process used. The scheme proposed by Saint-Gobain was tested in the laboratories of the CEA with fuel elements, some of which were irradiated (approx. 20,000 MWd/t). These experiments made it possible to determine the decontamination factors that could be obtained in an industrial installation and to give some indications of the purity of the finished products, the yield of fissile material, and the safety margins of the process. They also make it possible to define the role of certain elements, in particular Zr, which accelerates the degradation of TBP. The utilization of a complexing agent of Zr with hydrofluoric ion in low concentration for the extraction, makes it possible to improve very appreciably the results of the operation in the plant without leading to extensive modification in the installations. (tr-auth)

49882 (CEA-CONF-1359) APPARATUS FOR THE REPROCESSING OF HIGHLY IRRADIATED FUELS. Michel, Pierre; Dollfus, Jacques (Commissariat a l'Energie Atomique, [Paris] (France)). [1969]. 21p. (In French). (CONF-690535-5). Dep. CFSTI (U. S. Sales Only).

From IAEA Panel on Reprocessing of Highly Irradiated Fuels, Vienna, Austria.

The oxide-base fuels that were subjected to high levels of radiation pose new problems for their chemical reprocessing by their nature and by their high specific activity. The presence of cladding insoluble in nitric acid complicates the initial reprocessing.

Some equipment for continuous dissolution is being studied at the Fontenay-aux-Roses center. The problem caused by the very high specific activity of the solutions to be purified can be surmounted by the use of extractors requiring short contact time. Contrary to some mixer-settlers and some pulsed columns, the centrifugal extractors seem to have reconciled the requirements of short standing time and large output. An original centrifugal extractor is being studied. An eight-stage model was tried for a long time for the extraction of pure plutonium. Experiments confirmed the value of this apparatus the extraction efficiency of which exceeds 99.99% with contamination by lower phases of less than 0.5%. From tests on active solutions at the pilot plant at Marcoule it will be possible to verify its efficiency for the extraction of plutonium and its decontamination from fission products. (tr-auth)

49883 (CEA-CONF-1360) REPROCESSING BY THE HALIDE VOLATILITY PROCESS OF ENRICHED IRRADIATED URANIUM ALLOYS. Bourgeois, Michel; Perrot, Michel (Commissariat a l'Energie Atomique, [Paris] (France)). [1969]. 17p. (In French). (CONF-690535-2). Dep. CFSTI (U. S. Sales Only).

From IAEA Panel on Reprocessing of Highly Irradiated Fuels, Vienna, Austria.

The reprocessing of enriched uranium alloys of the type uranium-aluminum or uranium-zirconium by fluoride volatility techniques is under experimentation in the ATTILA installation at the CEN at Fontenay-aux-Roses. Tests were conducted on irradiated U-Al or U-Zr alloys with extremely short cooling, from a few years to a few months. The last test showed a β activity of several tens of thousands of curies. The operations were developed in a completely satisfactory manner and the efficiency of the process and the good functioning of the equipment were confirmed. The uranium is recovered in the form of the hexafluoride with excellent decontamination factors. In the case of alloys for which the cooling time is less than 90 days, an activity due to ^{237}U and ^{131}I was observed. The recovery of uranium has to be determined exactly because of the tests dealing with the large quantities of alloy (an element of the Pegase type). (tr-auth)

49884 (CEA-CONF-1361) REPROCESSING OF IRRADIATED REACTOR RODS WITH RAPSODIE FAST NEUTRONS. Talmont, Xavier; Miquel, Pierre (Commissariat a l'Energie Atomique, [Paris] (France)). [1969]. 13p. (In French). (CONF-690535-7). Dep. CFSTI (U. S. Sales Only).

From IAEA Panel on Reprocessing of Highly Irradiated Fuels, Vienna, Austria.

The process used for reprocessing of fuels irradiated in the Rapsodie core is based on the selective extraction of uranium and plutonium by tributyl phosphate without separation of the two elements. The mixed oxide of uranium and plutonium is dissolved in nitric acid after cutting of the needles. The nitrates of uranium and plutonium are separated from the fission products in three liquid-liquid extraction cycles and then reprecipitated together by ammonia. Experiments were carried out on this process, and it was put into use in the laboratories at Fontenay-aux-Roses. The recent experiments carried out in the series of Cyrano shielded cells were performed with fuel irradiated at 40,000 MWd/t in Rapsodie. A plant named AT1, able to reprocess one Rapsodie core per year, was constructed at la Hague. It was placed in operation in January 1969. In spite of some occasional difficulties caused by the presence of insoluble fission products, the results obtained are very satisfactory so far as the yield of enriched uranium and of plutonium as well as the decontamination factors. The specifications imposed on the finished product are largely met. (tr-auth)

49885 (CEA-CONF-1362) REPROCESSING OF HIGHLY IRRADIATED PLUTONIUM-ALUMINUM TARGETS FOR PRODUCTION OF TRANSPLUTONIUM ELEMENTS. Chesne, Andre; Berger, Rene ([Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires]). [1968]. 12p. (In French). (CONF-690535-3). Dep. CFSTI (U. S. Sales Only).

From IAEA Panel on Reprocessing of Highly Irradiated Fuels, Vienna, Austria.

Four elements, containing, in all, 20.95 g of plutonium in the form of a plutonium-aluminum alloy with 10% plutonium, were irradiated in the EL3 reactor with an integrated flux on the order of 5×10^{21} n/cm^2. Their reprocessing was carried out in the Petrus cell at Fontenay-aux-Roses. The originality of the process has to do with the use of a nitric acid medium for all the operations and the use of tridodecylamine (TLA) for the separation of plutonium. The reprocessing consists of: sodium hydroxide and/or nitrate dissolution of the aluminum-clad plutonium-aluminum alloy; separation of the plutonium by two extraction cycles using TLA (5% by volume) in nitric acid medium each followed by a reextraction by a nitric-sulfuric acid solution; a separation of the transplutonium elements by two extraction cycles with bis(2-ethylhexyl) phosphate (3% by volume), each consisting of extracting the actinides and the lanthanides from a solution containing lithium and aluminum nitrates, then a selective reextraction of the transplutonium elements by a solution of lithium nitrate containing diethylenetriaminepantaacetate ions; and an amercium-curium separation by fixation on an anion resin followed by elution with a nitric acid solution containing a complexing agent. At the end of these reprocessing steps 2.6 g of plutonium, 150 mg of americium, and 15 mg of curium were obtained. The total yield of plutonium and the transplutonium elements was 97% and 90%, respectively. The decontamination factors were higher than 10^5. (tr-auth)

49886 (CEA-CONF-1363) CHEMICAL REPROCESSING OF HIGHLY IRRADIATED FUELS IN FRANCE. Sauteron, Jean; Faugeras, Pierre (Commissariat a l'Energie Atomique, [Paris] (France)). [1969]. 13p. (In French). (CONF-690535-6). Dep. CFSTI (U. S. Sales Only).

From IAEA Panel on Reprocessing of Highly Irradiated Fuels, Vienna, Austria.

The experience of the CEA in the reprocessing of highly irradiated fuels is relatively recent and has not yet passed the stage of laboratory studies and some experimental tests. It was obtained and is continuing to be developed in the radiochemical laboratories at Fontenay-aux-Roses, in the Marcoule pilot plant and at the "AT1" plant at la Hague (destined for the reprocessing of the irradiated fuel from the Rapsodie Reactor). This experience deals with the following irradiated fuels: enriched uranium oxides irradiated to 20,000 MWd/t in the EL3 Reactor (aqueous method-Fontenay), mixed UO_2-PuO_2 irradiated to 45,000 MWd/t in Rapsodie (aqueous method-Fontenay then plant AT1), U-Al alloys from the Pegase Reactor and U-Zr alloys from the submarine prototype (dry method-Fontenay), Pu-Al alloy from the Celestin Reactor (aqueous method-Fontenay then Marcoule Pilot Plant), and Pu-Al targets for the production of transplutonium elements (aqueous method-Fontenay). These studies of processing were complemented by chemical engineering studies dealing especially with extraction apparatus with short contact time (centrifugal extractors SGN-Robatel). The research is being carried out partially for the purpose of extending the limits of the aqueous method (higher rate of combustion and shorter time of cooling) and partially to determine the technical and economic possibilities of the dry method. (tr-auth)

49887 (CEA-CONF-1379) TECHNOLOGICAL AND ECONOMICAL ASPECTS OF IRRADIATED FUEL REPROCESSING BY FLUORIDE VOLATILITY METHODS IN FRANCE. Manevy, G.; Rochedereux, Y. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). [1969]. 23p. (CONF-690801-1). Dep. CFSTI (U. S. Sales Only).

From Symposium on Reprocessing of Nuclear Fuels, Ames, Iowa.

Data concerning the first five runs carried out in the ATTILA facility at FONTENAY-AUX-ROSES, on highly irradiated, highly enriched uranium alloys are given. Considerations on technological and radiochemical problems encountered are also developed. Current laboratory work concerning stainless steel-clad oxide type fuels from fast breeder reactors is described, with emphasis on original methods for decladding and fluorinating this kind of fuel. Some results concerning a comparative study of investments and processing costs for a 40 kg (U + Pu) oxide/day plant based on fluoride volatility method, are discussed. (auth)

49888 (CEA-CONF-1380) TECHNICAL PROGRESS AND ECONOMICAL ASPECTS OF AQUEOUS PROCESSING. Michel, P. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). [1969]. 25p. (CONF-690801-2). Dep. CFSTI (U. S. Sales Only).

From Symposium on Reprocessing of Nuclear Fuels, Ames, Iowa.

In France, two industrial plants are processing metallic fuels from natural uranium, graphite, gas-cooled reactors (Marcoule, La Hague). Since their startup, modifications, either in the process or in the equipment, were made, which, in addition to an expected improvement in the plant operation, led to an experience on industrial scale and confirmed the results obtained in laboratory and pilot plants. In the future, problems of processing highly irradiated oxides remain to be solved, especially those related to fuel specific activity (volatile or weakly soluble fission product content, solution heat release, solvent damage, etc...). Tests involving all available technical means were undertaken to find suitable solutions. Technical and economic studies are being made to help find out which technical improvements would appreciably lower processing cost. (auth)

49889 (CEA-CONF-1381) SOLVENT EXTRACTION IN THE CHEMICAL REPROCESSING OF IRRADIATED NUCLEAR FUELS.

Michel, P. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). [1968]. 26p. (In French). (CONF-690919-1). Dep. CFSTI (U. S. Sales Only).

From 38th International Conference of Industrial Chemistry, Istanbul, Turkey.

In order to reprocess irradiated fuels, solvent extraction from solutions of the nitrates was shown to be particularly successful. The problems are more difficult when the fuels are irradiated at high levels. It was thought that they could be resolved by means of an improvement in the process consisting of complexing zirconium with fluoride ions. The apparatus used (mixer-settlers, pulsed columns, centrifugal extractors) all have their limits. The centrifugal extractors, which decrease the time of contact, appear to be very promising as a means of resolving the problem of high activities. Solvent extraction is going to be extended likewise to the recovery of certain fission and transuranium elements in the solutions of the fission products. Finally, some of the studies being made should permit the automatization of the extraction operations. (tr-auth)

49890 (DOCKET-50201-19) WEST VALLEY REPROCESSING PLANT. Final Safety Analysis Report, Revision 4. (Nuclear Fuel Services, Inc., West Valley, N. Y.). Sept. 30, 1969. 221p. Dep. CFSTI.

Revisions to various sections of the Final Safety Analysis Report for the West Valley Reprocessing Plant are given. The following sections were changed to reflect the results of the first three years of operation of the facility: introduction, detailed process description, equipment description, engineering analysis of the plant, protection of the public, and plant operation. Eight drawings were also revised. (M.C.G.)

49891 (DOCKET-50201-20) WEST VALLEY REPROCESSING PLANT. License No. CSF-1: Request for Final License. (Nuclear Fuel Services, Inc., West Valley, N. Y. New York State Atomic and Space Development Authority, New York). Oct. 2, 1969. 7p. Dep. CFSTI.

Information is presented in support of a request for a final operating license for the West Valley Reprocessing Plant. (M.C.G.)

49892 (INR-1068) PRELIMINARY CALCULATIONS OF THE HYDROCYCLONE CONTACTOR TYPE M.P.H. Hoffmann, Przemyslaw M. (Institute of Nuclear Research, Warsaw (Poland)). 1969. 22p. (In Polish). Dep. CFSTI (U. S. Sales Only).

The necessity of reprocessing highly burned up nuclear fuels requires new technological solutions. This problem can be solved by minimizing the time of contact between the aqueous and organic phases in the solvent extraction process. Centrifugal contactors allow the time of contact to be reduced by 2 to 3 orders of magnitude. Theoretical considerations concerning a centrifugal extractor of the type mixer–pump–hydrocyclone in which the time of contact between the phases is about 4 sec and the efficiency 1 l/min, are given. (auth)

49893 (INR-1072) SOLVENT EXTRACTION METHODS FOR THE SEPARATION OF Ce(IV). Sozanski, Adam (Institute of Nuclear Research, Warsaw (Poland)). 1969. 24p. (In Polish). Dep. CFSTI (U. S. Sales Only).

A review on the oxidation and separation of cerium from rare earth elements by solvent extraction methods is given. Possibilities for application of the method to large-scale operation are discussed. (122 references) (auth)

49894 (KFK-989) FAST CONTACTORS IN THE WAK. Roth, B. F.; Knoch, W. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Heisse Chemie). June 1969. 21p. (CONF-690535-8). Dep. CFSTI (U. S. Sales Only).

From IAEA Panel on Reprocessing of Highly Irradiated Fuels, Vienna, Austria.

Conventional mixer-settler batteries were designed for use in the WAK extraction steps. The residence time of the organic phase in the high-activity region is about 15 min. The use of fast contactors is most advantageous in the coextraction step of the first extraction cycle, where the majority of the fission products is still present. At comparable throughput the residence time could be decreased by a factor of 20. The extraction and strip batteries have 12 stages each. Equipment design and laboratory tests are described. (M.C.G.)

49895 (ORNL-4235) UNIT OPERATIONS SECTION QUARTERLY PROGRESS REPORT, OCTOBER-DECEMBER 1967. Whatley, M. E.; Haas, P. A.; McNeese, L. E.; Ryon, A. D.; Watson, D. C. (Oak Ridge National Lab., Tenn.). Oct. 1969. Contract W-7405-eng-26. 82p. Dep. CFSTI.

Research progress is reported on chemical engineering research, engineering separation of macromolecular and biological substances, sol-gel process development, thorium fuel cycle studies, power reactor fuel processing, and molten-salt reactor processing studies. (M.C.G.)

49896 (ORNL-4364) UNIT OPERATIONS SECTION QUARTERLY PROGRESS REPORT, JANUARY-MARCH 1968. Whatley, M. E.; Haas, P. A.; McNeese, L. E.; Ryon, A. D.; Watson, C. D. (Oak Ridge National Lab., Tenn.). Oct. 1969. Contract W-7405-eng-26. 44p. Dep. CFSTI.

Tests were made to evaluate flow capacities and mass-transfer efficiencies of the prototype stacked-clone contactor in a system that simulated conditions of an FBR fuel reprocessing flowsheet. Uranium processing rates as high as 41 kg/day were realized at stage efficiencies of about 50%. A molten-salt breeder reactor (MSBR) will be fueled with a molten fluoride mixture that will circulate continuously through the reactor core and the primary heat exchanger. A close-coupled processing facility for removing fission products and fissile materials from this mixture will be an integral part of the reactor system. Low-pressure distillation is one method being considered for separating the rare earth fission products from the more volatile components of the fuel salt. Experimentally determined relative volatilities indicate that adequate removal of the rare earth fluorides from fuel salt can be accomplished. Results of distillation experiments with nonradioactive salt having the composition of the MSRE fuel carrier salt, $LiF-BeF_2-ZrF_4$ (65-30-5 mole %), are presented. A flowsheet that uses reductive extraction for isolating protactinium from a single-fluid MSBR was proposed, and results of the performance of the isolation system under steady-state conditions were calculated. These calculations were based on laboratory data on the distribution of materials of interest between molten salt and liquid bismuth containing a reductant. The continuous fluorination of a molten salt is being studied as a means of removing uranium. Equipment is being developed for the continuous removal of UF_6 from a salt stream by countercurrently contacting the salt with fluorine in a salt-phase-continuous system. The equipment will be protected from corrosion by freezing a layer of salt on the vessel wall; the heat necessary for maintaining molten salt adjacent to the frozen salt layer will be provided by the decay of fission products in the salt stream. Initial experiments designed to demonstrate the operability of a frozen-wall fluorinator, using a countercurrent flow of molten salt and an inert gas, were completed. (M.C.G.)

49897 (PHS-999-RH-33, pp 160-8) ENVIRONMENTAL CONTAMINATION FROM ATOMIC PLANTS. Mawson, Collin A. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.).

Following the realization in the early 1950's that Canada had developed excellent processing procedures, it was decided to concentrate on the development of available nuclear power industry. With this decision it was necessary to face the waste disposal problem as well. The steps taken since that time by Canada to develop an efficient nuclear waste disposal system are briefly outlined. (E.R.B.)

49898 (UJV-2242-CH) ISOLATION OF RADIOCAESIUM FROM A FISSION PRODUCT MIXTURE BY MEANS OF SORPTION ON VANADIUM(IV) HEXACYANOFERRATE. Krtil, J.; Mencl, J. (Ceskoslovenska Akademie Ved, Rez. Ustav Jadernеho Vyzkumu). Aug. 1969. 8p. Dep. CFSTI (U. S. Sales Only).

A method for isolation of ^{137}Cs from acidic solutions of fission products is described, in which vanadyl ferrocyanide is used as a selective ion exchanger for cesium. The method was verified by isolation of ^{137}Cs from a fission products mixture with yields about 99.9% and with the total accuracy ±1%. (auth)

49899 PAPER CHROMATOGRAPHIC SEPARATION OF THE RARE EARTH ELEMENTS USING FILTER PAPER IMPREGNATED WITH POTASSIUM CHLORIDE. Nagai, Hideo; Ono, Hirobumi (Kumamoto Univ., Japan). Bunseki Kagaku, 18: 1063-7(Sept. 1969). (In Japanese).

In paper chromatography of the rare earth elements, the tailing was remarkably reduced with the impregnation of filter paper with alkali metal chlorides. In addition an attempt was made to find the developing solvent which was capable of effecting the largest differences in R_f values between the separated bands of ions. A mixture of dioxane and acetate buffer pH 4.0 to 5.0 (4:1 in volume) added with 20 mg/ml 8-hydroxyquinoline(oxine) gave the best results at 30° in many cases. Light lanthanons (from lanthanum to europium) except praseodymium or neodymium could be separated with one development. Praseodymium and neodymium in the absence of other rare earths separated by using a slightly modified developer. The middle and heavy lanthons could also be separated except in the case of mutual separation of adjacent ions. (NSA of Japan)

49900 EXTRACTION STUDIES OF THE GROUP IIIB–VIIB ELEMENTS AND THE LANTHANIDES UTILIZING BIS(2-ETHYLHEXYL)ORTHOPHOSPHORIC ACID. Qureshi, I. H.; McClendon, L. T.; LaFleur, P. D. (National Bureau of Standards, Washington, D. C.). Radiochim. Acta, 12: 107-11(Aug. 1969).

The extraction behavior of the group IVB to VIIB elements and the lanthanides from 1 to 11 M hydrochloric, perchloric, and nitric acid solutions into 0.75 M bis(2-ethylhexyl) phosphate solution has been studied. The group IVB elements and scandium exhibit high extraction which is independent of hydrogen ion concentration; the group VIIB elements are essentially unextracted. The extraction of some elements of group VB and VIB and of the lanthanides reaches a minimum and increases with increasing acidity. This behavior is attributed to a change in extraction mechanism. (auth)

49901 ACIDIC ORGANOPHOSPHORUS EXTRACTANTS. IX. EXTRACTION OF SOME LANTHANIDES BY MEANS OF DIBUTYLPHOSPHORIC ACID FROM STRONG ACIDIC MEDIUM. Navratil, O.; Dubinin, I. (Faculty of Natural Science, Brno). J. Inorg. Nucl. Chem., 31: 2927-32(Sept. 1969).

The distribution of ^{141}Ce, $^{152,154}Eu$, ^{160}Tb, and ^{168}Tm between aqueous perchloric, nitric, or hydrochloric acid and dibutylphosphoric acid solution in benzene was studied. Beyond a certain limiting concentration of the mineral acid in the aqueous phase, a change of the extraction mechanism takes place, the $MX_3(HDBP)_3$ complexes being extracted by the solvation mechanism (X = ClO_4, NO_3, Cl). This extraction mechanism is independent of the initial concentration of hydrogen ions and of the atomic number of rare earth elements. (auth)

49902 ACIDIC ORGANOPHOSPHORUS EXTRACTANTS. X. EXTRACTION OF STRONTIUM WITH DI-p-(1,1,3,3-TETRAMETHYLBUTYL)PHENYL PHOSPHORIC ACID. Sistkova, N. V.; Kolarik, Z.; Pankova, H. (Nuclear Research Inst., Rez, Czech.). J. Inorg. Nucl. Chem., 31: 2911-17(Sept. 1969).

The solvent extraction of strontium with bis-p-(1,1,3,3-tetramethylbutyl)phenyl phosphoric acid was studied radiometrically. The effects of the concentration of hydrogen and sodium ions in the aqueous phase and of the nature of diluent on the extraction efficiency and on the composition of the extractable complexes are discussed. (auth)(UK)

49903 FUELS. Gauthron, M. pp 1-26 of Genie Atomique. Tome II. Saclay, France, Institut National des Sciences et Techniques Nucleaires. Paris, Presses Universitaires de France, 1968. (In French).

The uranium–thorium fuel cycle is briefly outlined. The three primary steps in the processing of nuclear fuels in this cycle are the extraction of uranium from the ore, processing of the irradiated fuel and the extraction of Pu, and the isotopic separation of ^{235}U. Each of these is described. The physical and chemical properties of U, Pu, and Th and the behavior of these metals and their most important alloys and compounds in a reactor are described. (J.S.R.)

49904 THE DISTRIBUTION OF SOME SALTS OF UNIVALENT METAL IONS AND 2,4-DINITRO-N-PICRYL-1-NAPHTHYLAMINE BETWEEN WATER AND NITROBENZENE PHASE. Rais, J.; Kyrs, M. (Inst. of Nuclear Research, Rez, Czech.). J. Inorg. Nucl. Chem., 31: 2903-10(Sept. 1969).

The extraction of alkali metal salts of α-hexyl (2,4-dinitro-N-picryl-1-naphthylamine) into nitrobenzene was studied colorimetrically and radiometrically. The affinity of the α-hexyl anion for nitrobenzene, as compared with that of dipicrylamine, expressed as the equilibrium exchange constant for the reaction $\alpha^-_{aq} + DPA^-_{org} \rightleftharpoons \alpha^-_{org} + DPA^-_{aq}$ is given by $\log K^e_{DPA} = 0.85$. The extraction exchange constants K^e_{Rb}, K^e_{Cs}, and K^e_{Li} are practically the same as for dipicrylamine. The dissociation constant pK^e_{HX} of α-hexyl in nitrobenzene saturated with water was estimated to be 9.75. The solubilities of caesium α-hexylate in water and nitrobenzene are given. (auth) (UK)

49905 SOLVENT EXTRACTION OF RUTHENIUM FROM AQUEOUS HYDROCHLORIC AND HYDROBROMIC ACID SOLUTIONS. I. Meier, H.; Boesche, D.; Zimmerhackl, E.; Albrecht, W.; Hecker, W.; Menge, P.; Ruckdeschel, A.; Unger, E.; Zeitler, G. (Staatlichen Forschungsinstitut fuer Geochemie, Bamberg, Ger.). Mikrochim. Acta, No. 5, 1083-96(1969). (In German).

The various organophosphorus compounds exhibit a graded extraction capability toward ruthenium(III) halogen complexes such as is also characteristic of osmium halogen complexes. The order is: tripropyl phosphate < tributyl phosphate < tributyl phasphite < trioctylphosphine oxide with higher distribution coefficients in HBr than in HCl solutions. The practical attainable maximum values are at P = 78% in the case of trioctylphosphine oxide. An extraction mechanism corresponding to the osmium extraction was derived from the measured dependence of the distribution of various parameters such as acid concentration, dilution, etc. Also discussed are the reasons for the poorer extractability of ruthenium halogen complexes in comparison with the osmium complexes on the basis of the lower addition possibility of the organophosphorus molecule. (auth)

49906 SEPARATION OF CARRIER-FREE ^{76}As FROM THE ^{78}Se TARGET. Inarida, M.; Shimamura, A. (Inst. of Physical and Chemical Research, Saitama, Japan). Radiochem. Radioanal. Lett., 2: 87-92(Oct. 13, 1969).

Solvent extraction was used for the separation of As from a Se target in order to obtain carrier-free ^{76}As of high radiochemical purity. (auth)

49907 BITHERMIC–BIBARIC INSTALLATION FOR SEPARATING DEUTERIUM BY ISOTOPIC EXCHANGE BETWEEN THREE FLUIDS. Peculea, M.; Boian, M. Rev. Chim. (Bucharest), 20: 429-32(July 1969). (In Rumanian).

Results are given of experiments carried out in a pilot plant for isotopic separation in a bithermic–bibaric system based on an isotopic exchange process between three fluids, water–water vapor–hydrogen. The efficiency of the isotopic exchange process, as a function of the thermodynamic parameters, was determined. The main characteristics of such an installation, its separation capacity, were determined experimentally as a function of temperature and pressure differences between the two columns. The validity of the equations describing the development of the process was also checked. (auth)

49908 FLUIDIZED-BED FLUORINATION OF UO_2–PuO_2–FISSION PRODUCT PELLETS WITH BrF_5 AND FLUORINE. PART 1. THE FLUORINATION OF URANIUM, NEPTUNIUM, AND PLUTONIUM. Anastasia, L. J. (Argonne National Lab., Ill.); Alfredson, P. G.; Steindler, M. J. Nucl. Appl. Technol., 7: 425-32(Nov. 1969).

Fluorination of simulated spent-fuel pellets of UO_2–PuO_2 was studied in a 2-in. dia. fluidized-bed reactor. When selective fluorination of uranium was performed at 250 to 350°C with BrF_5 and fluorination of plutonium was performed at 300 to 550°C with fluorine, neptunium distributed in both the UF_6 and PuF_6 products and residual plutonium in the fluidized bed was about 3% of the charge. (auth)

49909 INCREMENTAL COST CONSIDERATIONS RELATED TO PRODUCTION OF ENRICHED URANIUM. de la Garza, A.; Levin, S. A. (Union Carbide Corp., Oak Ridge, Tenn.). Nucl. Appl. Technol., 7: 456-65(Nov. 1969).

Fundamental considerations in setting operations of gaseous diffusion plants for minimum cost of enriched product were investigated. The significance of incremental costs is stressed. Information released by the USAEC is used in numerical illustrations. (auth)

49910 FLUIDIZED-BED FLUORINATION OF UO_2–PuO_2–FISSION PRODUCT PELLETS WITH BrF_5 AND FLUORINE. PART 2. PROCESS CONSIDERATIONS. Anastasia, L. J. (Argonne National Lab., Ill.); Alfredson, P. G.; Steindler, M. J. Nucl. Appl. Technol., 7: 433-42(Nov. 1969).

The fluorination step in a fluidized-bed fluoride volatility process was studied in a 2-in.-dia reactor using BrF_5 and fluorine as fluorinating agents and sintered alumina as the fluidized bed. Fuel pellets containing UO_2, PuO_2, and nonradioactive fission product oxides were pulverized by oxidation before uranium was selectively fluorinated with dilute BrF_5; plutonium was then fluorinated with concentrated recycled fluorine. Fission product elements added to the system simulated burnups of 10,000 and 30,000 MWd/t. Several aspects of the fluoride volatility process are discussed: effect of variations in process parameters on residual plutonium in the bed, distribution of selected fission products and ^{106}Ru tracer, demonstration of reduced plutonium losses by reuse of a single alumina bed to process three batches of pellets at each of the simulated burnups of 10,000 and 30,000 MWd/t, plutonium inventory in the reactor, and sampling the fuel charge for material balance and accountability. A processing step for a hybrid process incorporating leaching of the fluidized bed with nitric acid after uranium fluorination with BrF_5 was also demonstrated. (auth)

49911 INVESTIGATION OF THE EXTRACTION OF URANIUM (VI) BY TRIOCTYLAMINE FROM H_2O–HNO_3–$H_2C_2O_4$ SOLUTION. Lipovskii, A. A.; Kuzina, M. G. Zh. Neorg. Khim., 14: 2474-8 (Sept. 1969). (In Russian).

A study of the extraction of U(VI) from HNO_3–$H_2C_2O_4$ solutions with trioctylamine showed the existence of extreme values of the distribution coefficients. The magnitude of the distribution coefficient change depends on the relative concentration of HNO_3 and $H_2C_2O_4$. This relation is stipulated by the formation of different

complex compounds of uranyl containing the coordination of diverse acid ligands in the sphere of the uranium atom. (tr-auth)

49912 RECOVERY OF STRONTIUM BY MEANS OF A POLYANTIMONIC(V) ACID CATION EXCHANGER. Konecny, C.; Kourim, V. (Nuclear Research Inst., Rez, Czech.). Radiochem. Radioanal. Lett., 2: 47-52(Oct. 13, 1969).

The preparation of polyantimonic(V) acid (PAA) under various experimental conditions was investigated in order to ascertain the suitability of individual PAA species as ion exchangers for the recovery of strontium from dilute nitric acid solutions. (auth)

49913 COMPARISON OF ELUTING AGENTS FOR THE ION-EXCHANGE PURIFICATION OF PROMETHIUM. Wheelwright, E. J. (Battelle-Northwest, Richland, Wash.). J. Inorg. Nucl. Chem., 31: 3287-93(Oct. 1969).

Laboratory experiments showed that NTA (nitrilotriacetic acid) is markedly superior to EDTA (ethylenediaminetetraacetic acid) or DTPA (diethylenetriaminepentaacetic acid), the complexing agents previously used, for kilogram-scale ion-exchange purification of promethium. With NTA elution at 60°C, the position of yttrium is changed from the critical Sm–Pm–Nd zone (with DTPA the sequence is Sm–Y–Pm) to a place ahead of gadolinium to yield an elution order: Y, Gd, Eu, Sm, Pm, Nd, Pr. As a result of faster kinetics in the NTA system, a 100% increase in the rate of band advance, compared to the rate obtained in the previously used DTPA process, can be achieved with equal or superior separation efficiency. The time required for a 300,000 Ci purification run was reduced from 21 days with EDTA or 6 days with DTPA to less than 3 days with NTA. (auth) (UK)

49914 THE EXTRACTION CHROMATOGRAPHY OF AMERICIUM, CURIUM, BERKELIUM, AND CALIFORNIUM WITH DI(2-ETHYLHEXYL)ORTHOPHOSPHORIC ACID. Horwitz, E. P.; Bloomquist, C. A. A.; Henederson, D. J.; Nelson, D. E. (Argonne National Lab., Ill.). J. Inorg. Nucl. Chem., 31: 3255-71(Oct. 1969).

The extraction chromatography of Am(III, Cm(III), Bk(III), and Cf(III) was studied using bis(2-ethylhexyl) orthophosphate (DEHPA) adsorbed on hydrophobic diatomaceous earth (Celite-545). Dilute nitric and hydrochloric acid solutions were used as the elutriants. The effect of flow rate on the plate height was measured and compared for Cm(III), Am(III), Bk(III), Cf(III), and Es(III) at 25°C. The distribution coefficients of Am(III), Cm(III), Bk(III), and Cf(III) and the separation factors Cm(III)/Am(III), Bk(III)/Cm(III), Cf(III)/Bk(III), and Cf(III)/Cm(III), were studied as a function of temperature, with HDEHP adsorbed on Celite and HDEHP in heptane. The extraction chromatography method was applied to the separation of Bk(III) and Cf(III) and to the separation of Cm(III) and Cf(III). (auth) (UK)

49915 ISOLATION OF PLUTONIUM IN CHLORIDE MEDIA. II. SOLVENT EXTRACTION WITH DI(2-ETHYLHEXYL)PHOSPHORIC ACID. Fardy, J. J. (Australian Atomic Energy Commission, Lucas Heights). J. Inorg. Nucl. Chem., 31: 3247-54(Oct. 1969).

Plutonium extraction by bis(2-ethylhexyl) phosphate from hydrochloric acid solution varies with the different valence states in the order Pu(IV) > Pu(VI) > Pu(III). Behavior of transplutonium actinides, corrosion products, and fission products was examined in this system, and it was found that by extracting Pu(IV) from 6M HCl it can be separated from most of these ions. Separation from zirconium, which is quantitatively extracted, is achieved by removing the plutonium from the organic phase as Pu(III) by adding an organic-soluble reductant. Stripping of plutonium by aqueous-soluble reductants at elevated temperature is also feasible. Results of laboratory studies to determine optimum conditions for plutonium recovery and decontamination in the production of transplutonium actinides are presented. (auth) (UK)

49916 SEPARATION FACTORS OF ADJACENT RARE EARTHS BETWEEN THE AQUEOUS AND RESIN PHASES IN THE PRESENCE OF EDTA. Noguchi, Masaru; Yoshifuji, Akashi; Hagiwara, Zenzi (Tohoku Univ., Sendai). Bull. Chem. Soc. Jap., 42: 2286-91(Aug. 1969).

In order to find the accurate separation factors of two adjacent rare earths between the aqueous and resin phases, measurements were performed at 30°C in the presence of EDTA and using Dowex 50W, X-8, 50 to 100 mesh. The following results were obtained under the same experimental conditions as were employed in ion-exchange system for the isolation of the rare earth series. The separation factors were 2.05 for Er–Tm, 1.88 for Dy–Ho, 1.61 for Y–Dy, 1.76 for Tb–Y, 1.30 for Eu–Gd, and 3.77 for Sm–Nd. In the Er–Tm separation factor, a fairly large discrepancy was observed between the calculated and experimental values. It is concluded from the experimental results that the separation factors of lanthanons should be directly measured. (auth)

49917 COLLECTION OF URANIUM IN SEA WATER. III. CONCENTRATION OF URANIUM IN DILUTE SOLUTIONS WITH SURFACE ACTIVE AGENTS. Ogata, Noboru (Odawara Salt Experiment Station, Kanagawa, Japan); Kakihana, Hidetake. Nippon Genshiryoku Gakkaishi, 11: 469-76(Aug. 1969). (In Japanese).

A study was made of foam separation with various kinds of surface active agents and adsorption separation with metallic soaps and laurylamine salts, for the purpose of concentrating trace amounts of U in various kinds of salt solutions and sea water. The optimum conditions were influenced by the chemical components of the solutions. The most effective methods brought to light were as follows: foam separation with laurylamine acetate on neutral solutions of various salts, alkylbenzyl ammonium chloride on weak alkali solution, and laurylbetain on acidic solution of nitrate and seawater; adsorption of U contained in seawater by Fe, Ti, and Zn soaps; in acidified seawater, was adsorbed by Mg, Ti, and Ni soaps; adsorption of U in chloride, sulfate, and nitrate solutions by Ca soap; uranium in seawater was adsorbed only when acidified; and adsorption of U in the various salt solutions by laurylamine phosphate. (NSA of Japan)

49918 SOLVENT EXTRACTION OF SALICYLATES. III. THE DISTRIBUTION OF TRIVALENT CATIONS BETWEEN AQUEOUS SOLUTION AND TRIBUTYL PHOSPHATE IN THE PRESENCE OF SALICYLIC ACID. Aggett, J.; Crossley, P.; Hancock, R. (Univ. of Auckland, New Zealand). J. Inorg. Nucl. Chem., 31: 3241-6(Oct. 1969).

The distribution of iron(III), aluminum(III), and promethium(III) between TBP and aqueous solution in the presence of salicylic acid was examined. Both iron(III) and aluminum(III), which exist in aqueous solution as chelates with the doubly-charged salicylate ion, extract as species of the type $M(C_7H_4O_3)(C_7H_5O_3)$. Promethium(III) which shows little tendency to chelate extracts as $Pm(C_7H_5O_3)_3$. (auth) (UK)

49919 THE Er–Tm SEPARATION FACTOR IN THE PRESENCE OF CHELATING AGENT AND ELUTION BEHAVIOR OF BINARY MIXTURES OF Er AND Tm. Hagiwara, Zenzi; Banno, Akira; Kamei, Akira (Tohoku Univ., Sendai). J. Inorg. Nucl. Chem., 31: 3295-3301(Oct. 1969).

In the presence of EDTA and sulfonated polystyrene resin, the Er–Tm separation factor suitable for the real elution system was measured at 60°C, and a value of 2.02 was obtained. At 60°C the rare earth bands involving binary mixture of Er and Tm were eluted down a copper retaining bed, using approximately 0.015 M EDTA solution buffered with ammonium hydroxide. From several sets of experimental data obtained by steady-state elutions of these heavier rare earths the plate height values were calculated on the basis of rate theory and countercurrent extraction. The plate height values due to film diffusion were in agreement with the HETP values from countercurrent extraction. It was also found that there is a linear relation between the plate height based on film diffusion and the flow rate. (auth) (UK)

49920 PYROCHEMICAL EXTRACTION OF POLONIUM FROM IRRADIATED BISMUTH METAL. Schulz, Wallace W. (Battelle Memorial Inst., Richland, Wash.); Schlefelbein, Gary F.; Bruns, Lester E. Ind. Eng. Chem., Process Design Develop., 8: 508-15 (Oct. 1969).

In a simple pyrochemical process, developed for recovery of ^{210}Po from neutron-irradiated bismuth metal and performed in nitrogen or argon, fused sodium hydroxide is used to extract polonium from molten (400 to 500°C) bismuth. This pyrochemical scheme is very efficient and operates satisfactorily over a wide range of temperatures and reactant ratios. Typically, 97% of the ^{210}Po transfers to the caustic soda phase in a single fusion of the irradiated bismuth with as little as one quarter its weight of sodium hydroxide. Liquid-liquid solvent extraction techniques are applicable for recovery and purification of the polonium from nitric acid solutions of the sodium hydroxide melt. An important process advantage is that the bismuth is maintained as the metal and can be recycled directly to a nuclear reactor for further irradiation. The process was tested with pound quantities of irradiated bismuth containing 6 to 7 curies of ^{210}Po; it appears suitable for recovery of kilogram amounts of polonium for use in isotopic power sources. (auth)

49921 SIMPLE METHOD FOR CHECKING ON RADIOACTIVE WASTE. Otto, R.; Hecht, P. (Institut fuer Angewandte Radioaktivitaet, Leipzig). Atompraxis, 15: 268-71(July-Aug. 1969). (In German).

A simple method for routine checks of activity in waste from isotope laboratories is reported. The waste samples are boiled down while still in the measurement dishes, and the β and α activity in the residue is measured with an arrangement consisting of 3 parallel-switched bell counting tubes, or with a scintillation counter. The threshold of detection for β emitters is 3×10^{-7}

μCi/ml (referred to ^{40}K) and for α emitters is 8×10^{-8} μCi/ml (referred to ^{239}Pu). (auth)

49922 REFINING OF TECHNICAL TELLURIUM. Breusov, O. N. Izobret., Prom. Obraztsy, Tovarnye Znaki, 45: No. 28, 179(1968). (In Russian).

For more complete removal of impurities, the initial powdered technical Te is first treated with mixtures of $Na_2S_2O_4$ or NH_3 and $K_3Fe(CN)_6$. (Selenium–Tellurium Abstr.)

49923 METHOD FOR TREATING RADIOACTIVE LIQUID WASTES WITH AN ION-EXCHANGE MEMBRANE. Sugimoto, Senichi (to Japan Atomic Energy Research Inst.). Japanese Patent 1969-11777. May 29, 1969. Filed July 4, 1964.

The method proposed makes possible the concentration of radioactive material in radioactive liquid wastes beyond the usual degree by desalting; it is essentially electrodialysis employing an ion exchange membrane. Examples of the removal showed about 73-fold concentration from the original liquid wastes; the concentrated liquid can be disposed of in an ordinary manner. The over-all operation consists of two stages. In the first stage, radioactive material is removed as far as possible by electrodialysis employing an ion-exchange membrane. Then, in the second stage, electrolytes, which are not radioactive, are added to the solution, to increase the concentration. It is then desalted by electrodialysis with an ion exchange membrane. Salts, acids, or bases of elements, similar in chemical properties to the radioactive elements, may be used as electrolytes. The mobility of those electrolytes through the membrane is similar or lower than that of the radioactive elements. (NSA of Japan)

49924 MODEL INVESTIGATIONS OF ISOTOPE FRACTIONATION OF NATURAL GAS COMPONENTS DURING MIGRATION. May, F. (Forschungsinstitut fuer die Erkundung und Foerderung von Erdoel und Erdgas, Gommern, Ger.); Freund, W.; Mueller, E. Peter; Dostal, K. P. Z. Angew. Geol., 14: 376-80(July 1968). (In German).

Tests made to elucidate the physicochemical conditions of gas migration include a study of changes in isotope ratio of CH_4 in a CH_4–N_2 mixture on a 40-m column. A water-containing molecular sieve (5 Å) was used. A more rapid migration for $^{13}CH_4$ than for $^{12}CH_4$ was found. The $\delta^{13}C$ value of residual gas after test periods of ca. 3000 hr was decreased over the value of the initial gas by amounts ranging from 0.39 to 0.81‰. A similar test on isotope fractionation in N_2 showed an increase in $\delta^{15}N$ of 0.70‰. Static adsorption tests confirmed that $^{12}CH_4$ was more strongly adsorbed than $^{13}CH_4$, as the column results above require. Studies with ethane indicated that similar enrichment of $^{13}C^{12}CH_6$ over $^{12}C_2H_6$ in the gas phase occurs, and that the enrichment occurs whether or not the molecular sieve is dry of water-containing. Fractionation over sandstone gave the same qualitative results. Thus the results are in agreement with models for gas migration in the Thuringian Basin. (BBB)

49925 PROCESS OF SEPARATION IN THE ZIRCONIUM–HAFNIUM SYSTEM BY LIQUID–LIQUID EXTRACTION, UTILIZING DIBENZYLPHOSPHORIC ACID. Courtemanche, Pierre; Merlin, Jean-Claude (to Centre National de la Recherche Scientifique). British Patent 1,164,364. Sept. 17, 1969. Priority date July 5, 1966, France.

A method for the separation of zirconium and hafnium by liquid–liquid extraction is described. The extraction agent, an organic phase containing dibenzylphosphoric acid, extracts an immiscible aqueous phase that contains a solution of zirconium and hafnium in a strong inorganic acid. The best results were obtained with an organic phase constituted by a dilute solution of dibenzylphosphoric acid in a benzene–hexone mixture (50–50 vol %). For the aqueous phase a strong inorganic acid, such as nitric, hydrochloric, or perchloric acid was used. An economical method for the preparation of dibenzylphosphoric acid is also described. (G.M.C.)

49926 SEPARATION OF THORIUM FROM MONAZITE BY A SOLVENT EXTRACTION METHOD. Jen, Chun-hwa; Chen, Meicheng (Union Industrial Research Inst., Taipei, Taiwan). Hua Hsueh, No. 4, 148-54(Dec. 1968). (In Chinese).

Previous methods for extraction of Th using tributyl phosphate, amines, and phosphonates, as well as batch extraction, salting-out, and re-extraction methods, were compared, and a new technique was developed. In the procedure described a solution of thorium nitrate was extracted with mesityl oxide as solvent and aluminum nitrate as salting-out agent, and then re-extracted with water. When the concentration of thorium nitrate solution was moderate, the purity of the separated thorium oxide was more than 99% as obtained by a single extraction. In addition to mesityl oxide, several other extractants were tested. The resulting purity of the extracted thorium oxide with each was as follows: a mixture of ethyl acetate and acetone 91.12 to 96.79%, tributyl phosphate 93.4 to 97.3%, butyl lactate 89.0%, methyl n-hexyl ketone 93.9%, and capryl alcohol 97.1%. (BBB)

49927 SEPARATION OF THORIUM FROM RARE EARTHS BY CATION EXCHANGE RESIN, DOWEX 50. Chen, Sung-hsien (Union Industrial Research Inst., Taipei, Taiwan). Hua Hsueh, No. 3, 112-17(Sept. 1968). (In Chinese).

The determination of Th in minerals is often interfered with by the presence of rare earths. Several previously reported methods using ion exchange and chelation techniques for separation of Th from other cations are discussed. To simplify the method of determination, the separation of Th from rare earths using the ion exchange method was investigated. Because of the different affinity of Th and rare earths for Dowex 50 in different mineral acids, it was shown that the ion exchange method can be used effectively for the separation of Th from rare earths. In the technique which was developed, a 1.15 × 70 cm column of Dowex 50-W × 4 (100 to 200 mesh) in the H^+ cycle was used. The elutants used were 0.5M and 1M H_2SO_4, 2M HCl, and 3M H_2SO_4. With a 20-ml Dowex 50-W column and 190 ml 2M HCl followed by 3M H_2SO_4 it was possible to achieve 98% or greater purity ThO_2 separated from a mixture of CeO_2 and rare earth oxides. (BBB)

49928 STUDY OF EXTRACTION OF THORIUM BY AMMONIUM THIOCYANATE SOLUTION AS AN ELUTING AGENT. Chen, Meicheng (Union Industrial Research Inst., Taipei, Taiwan). Hua Hsueh, No. 3, 118-23(Sept. 1968). (In Chinese).

It was shown that rare earths can be removed completely from the crude thorium compound which is decomposed from monazite, by using an AG1-X8 (200 to 400 mesh) resin column and ammonium thiocyanate solution as the eluting agent. The purity of thorium dioxide in mixed oxides can be increased from 57% to 99.5% by eluting with 0.1M ammonium thiocyanate–90% methanol solution, or by using more steps with a 0.1M ammonium thiocyanate–95% acetone solution. The yield of thorium dioxide is quite high in these cases, and may approach 98%. Analytical methods employing xylenol orange alizarin S, and ethylenediaminetetraacetic acid are described. The distribution coefficient values [K_d = (meq Th on the resin/g dry resin)/(meq Th in solution/ml solution)] are tabulated for the runs carried out under various conditions with the different eluants. (BBB)

EARTH SCIENCES

Geology and Hydrology

Refer also to abstracts 49733, 49747, 49752, 49950, 49951, 49973, 49975, 50199, 50200, and 50462.

49929 (CU-2493-10(App.A)) THE BEHAVIOR OF RADIOCARBON IN SURFACE WATERS OF THE GREAT BASIN. Thurber, David L.; Broecker, Wallace S. (Columbia Univ., Palisades, N. Y. Lamont-Doherty Geological Observatory). Sept. 30, 1969. 40p. (CONF-690817-2). Dep. CFSTI.

From Nobel Symposium, Uppsala, Sweden.

The exchange rate of carbon dioxide between the atmosphere and water affects the concentration of radiocarbon in solution in surface waters. Three approaches to the problem of carbon dioxide exchange are discussed, including a model for gas exchange, laboratory studies, and the measurement of exchange rates in natural systems. The Great Basin lakes include Great Salt Lake, Pyramid Lake, Mono Lake, and Walker Lake. The non-steady state approach used to study the lakes allowed not only an estimate of the exchange rate of carbon dioxide across the surface of the lake, but gave insight into the relative hydrologic contributions to the lakes. Since exchange of CO_2 across the lake surface is an important source of ^{14}C, it should be possible to estimate, from the morphology of the lake basin and from the characteristics of the probable hydrological sources, what the minimum $^{14}C/^{12}C$ will be. (J.C.W.)

49930 (CU-2493-10(App.B)) ^{222}Rn TO ^{226}Ra RATIOS IN CLOSED BASIN LAKES. Broecker, Wallace S. (Columbia Univ., Palisades, N. Y. Lamont-Doherty Geological Observatory). Sept. 30, 1969. Contract AT(30-1)-2493. 4p. Dep. CFSTI.

In an attempt to determine the rate of atmosphere-lake gas exchange for thermally stratified lakes, the ^{222}Rn and ^{226}Ra content in surface waters of three closed basin lakes in the Great Basin of the western United States was measured. The results were not promising for either Mono or Walker Lake and the radium content of Pyramid Lake has yet to be measured. (G.M.C.)

49931 (NYO-3860-2) RADIATION DOSIMETRY, CORRELATION, AND DATING OF CALCAREOUS DEEP-SEA CORES. Final Report. Johnson, Noye M. (Dartmouth Coll., Hanover, N. H. Dept. of Earth Sciences). Feb. 15, 1969. Contract AT(30-1)-3860. 103p. Dep. CFSTI.

Two studies performed to evaluate thermoluminescence dosimetry in pelagic sediments as related to geologic age and radioactivity are presented. Dosimetry values and alpha activities were measured at intervals along cores of foraminiferal lutite which collectively represented a complete stratigraphic section of the late Pleistocene. The mineralogy and concentrations of some trace elements in the cores were also determined, and their effects on the natural thermoluminescence were analyzed. The results showed a systematic increase of thermoluminescence dose equivalence and a systematic decrease of radioactivity with depth which is consistent with certain theoretical considerations. A model is suggested which relates measured alpha activities with dose equivalence. The ideal trend of increasing dose equivalence predicted by this model agrees well with experimental results in most cases. In general, relative age relationships may be obtained within and between cores by this method. At present, this method does not provide an independent means of dating deep-sea sediments, but it may serve as a valuable supplement to other techniques. It was concluded that useful time information from the thermoluminescence dosimetry of calcareous deep-sea sediments is apparently limited to the Pleistocene. (auth)

49932 (TID-25169) NEUTRON ACTIVATION TECHNIQUES FOR PRECIOUS METAL EXPLORATION. Final Report. Senftle, F. E. (Geological Survey, Washington, D. C.). Nov. 20, 1967. Contract AT(49-11)-2784. 35p. Dep. CFSTI.

A feasibility study has shown that an in situ irradiation of the ground with neutrons can produce sufficient induced radioactivity in some 30 elements to make detection and identification relatively easy. Extensive tests and two prototype field detectors for the detection of silver gave encouraging results. A mobile 150-kV positive ion accelerator is used as a source of 3-MeV or 14-MeV neutrons. The induced radioactivity is analyzed by a multichannel analyzer, and element identification is made on the basis of both energy and half-life. A similar study made on the precious and semiprecious metals indicated that no one technique is satisfactory for all the metals. Rather than build a practical field exploration device for the precious metals, a mobile neutron activation laboratory has been built to investigate the various parameters and techniques which can be used. Field tests have been made using both thermal and fast neutron reactions to detect gold. Two of the more promising methods are described and preliminary field results are given. (auth)

49933 (UCRL-Trans-10353) APPLICATION OF GAMMA-GAMMA LOGGING TO THE CONTROL OF WELL CEMENTATION UNDER THE CONDITIONS IN WESTERN SIBERIA. Gol'din, I. M. Translated by T. Watt for Univ. of California, Lawrence Radiation Lab., Livermore, from Razved. Geofiz., 23: 112-14(1967). 6p. Dep. CFSTI.

The results of using gamma-gamma logging (GGL) to measure and control the cementation of casing columns in Western Russia are presented. With this technique, it was possible to determine the depth, location, thickness, and eccentricity of concrete casings for wells. Cementograms obtained by GGL were used successfully to determine where more concrete was needed in casings, and, following the addition of concrete to such spaces, the logging method verified that the concrete fill had been accomplished. It is recommended that commercially available GGL cementometers be modified with temperature resistant components for work at high temperatures. (L.C.L.)

49934 DEPTH PREDICTION FOR EARTH-PENETRATING PROJECTILES. Young, C. Wayne (Sandia Labs., Albuquerque, N. M.). J. Soil Mech. Found. Div., Amer. Soc. Civil Eng., 95: 803-17(May 1969). (SC-R-69-1201).

An equation for predicting the depth to which a projectile will penetrate the Earth was developed using empirical data. A resulting monogram is presented which permits a graphic solution to the soil penetration problem and which considers the following parameters; projectile configuration, size, weight, soil consistency, and impact velocity. (L.C.L.)

49935 RADIOMETRIC SURVEY WITH A CAR-MOUNTED INSTRUMENT IN KUMANO DISTRICT. Obi, Nakamaru; Ujiie, Akira (Geological Survey of Japan, Kawasaki). Chishitsu Chosasho Geppo, 20: 185-96(Mar. 1969). (In Japanese).

In the Kumano district stretching over both Wakayama and Mie prefectures, located at the southeastern part of Kii peninsula, a reconnaissance radiometric survey for uraniferous ore deposits was carried out from February to March, 1965. A scintillation counter, equipped with a scintillator 5 inches in diameter and 2 inches in thickness, was mounted on a vehicle. The amount of gamma radioactivity along the routes of survey is discussed. No radioactive anomaly was detected in the survey. (NSA of Japan)

49936 TYPES OF URANIUM MIGRATION IN CARBON DIOXIDE WATER SYSTEMS OF ONE OF THE CAUCASIAN REGIONS. Kyuregyan, T. N.; Kocharyan, A. G. Izv. Akad. Nauk Arm. SSR, Nauki Zemle, 22: No. 1, 54-6(1969). (In Russian).

Hydrochemical studies were made on uranium migration in carbonated waters in the Caucasus Mountains, and the relation between water soluble uranium and dissolved CO_2 was correlated. Thermodynamic studies showed that uranium carbonate complexes were the most stable in the hypergenesis zone. Calculations of specimens analyzed locally showed that the relative content of uranyl dicarbonate complexes reduced after storage. Moreover, with the increase of the CO_3^{2-} ion the amount of uranyl tricarbonate increased. Data obtained revealed that dominating forms of U concentrations in the Caucasus Mountains, independent of the chemical composition, are uranyl dicarbonate and tricarbonate concentrations, which depend mostly on the alkali acid environment, general mineralization, and the total content of U. (R.V.J.)

49937 DISTRIBUTION OF THE RARER AND ORE ELEMENTS IN THE EL'DZHURTA INTRUSIVE MASSIF, KABARDA-BALKAR ASSR. Odikadze, G. L. (Caucasus Mineral Raw Material Inst., Tibilisi, USSR). Geochem. Int. (Engl. Transl.), 5: 1010-15(1968).

Translated from Geokhimiya, No. 10, 1211-17(1968).

Rare and ore elements are uniformly distributed in a porphyritic biotite granite of magmatic origin. High concentrations of Nb, Sn, Pb, Zn, Sc, Cs, and U are present, but deposits of any of these elements are absent. Molybdenum and tungsten, which are present in amounts similar to the average contents of silicic igneous rocks, however, form a major W-Mo deposit. It was concluded that geochemical specialization of an intrusive complex does not always serve as a guide to ore mineralization. (auth)

49938 THE CURRENT TRITIUM CONTENTS OF NATURAL WATERS. Vinogradov, A. P.; Devirts, A. L.; Dobkina, E. I. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Geochem. Int. (Engl. Transl.), 5: 952-66(1968).

Translated from Geokhimiya, No. 10, 1147-62(1968).

Tritium analyses were made on a number of water and plant samples collected primarily during 1966 to 1968 in the western USSR. The analyses were made by gas-proportional counting either of C_2H_2, made by reacting sample H_2O with ^{14}C free CaC_2, or of C_6H_6 made by hydrogenerating "dead" or sample C_2H_2 with H_2 from the sample H_2O. The counters were steel or copper in conventional steel shields with a ring of geiger guard counters in anticoincidence with the main counter. 2 σ detection limits for 1000 minute counts were 3 TU for C_6H_6 at 2 atmospheres and 18 TU for C_2H_2 at 1 atmosphere. No enrichment was done. The tritium content of atmospheric precipitation and water vapor near Moscow ranged from 400 to 800 TU (tritium units) in 1966 and from 40 to 300 TU in 1967. Lakes in the central and NW USSR ranged from 170 to 370 TU in 1967, while the Pakhva and Oka Rivers near Moscow in September 1967 had 65 and 34 TU, respectively. (auth)

49939 DILEMMA POSED BY URANIUM-SERIES DATES ON ARCHAEOLOGICALLY SIGNIFICANT BONES FROM VALSEQUILLO, PUEBLA, MEXICO. Szabo, Barney J. (Federal Center, Denver); Malde, Harold E.; Irwin-Williams, Cynthia. Earth Planet. Sci. Lett., 6: 237-44(July 1969).

In an attempt to date stone artifacts of Early Man excavated from several sites at the Valsequillo Reservoir, a few kilometers south of Puebla, Mexico, the uranium-series method was applied to bone samples known to be either from the same geologic formation as the sites or in direct association with the artifacts. The geologic context of the bones was studied and the archaeological sites were excavated. A date determined for bone associated with an artifact (Caulapan sample M-B-6) agreed with a radiocarbon date for fossil mollusks in the same bed and indicated man's presence more than 20,000 years ago. However, some of these bone dates exceed 200,000 years. Because such dates for man in North America conflict with all prior archaeological evidence here and abroad, the uranium-series dates are given as a possible stimulus for further mutual work in isotopic dating of archaeological material. A sample from the Lindenmeier archaeological site north of Fort Collins and another from a Pleistocene terrace along the Arkansas River, both in Colorado, were also dated. (auth)

49940 LOSS OF URANIUM FROM CRYSTALLIZED SILICIC VOLCANIC ROCKS. Rosholt, J. N. (Geological Survey, Denver); Noble, D. C. Earth Planet. Sci. Lett., 6: 268-70(July 1969).

Dense primarily crystallized silicic groundmass material from two welded ash-flow units and one lava flow of Tertiary age from the Western United States contain only 20 to 60 percent of the uranium present in nonhydrated glass from the rock units. These differences reflect loss of uranium from the crystallized specimens, probably as a result of ground water leaching. It appears likely that most crystallized silicic volcanic rocks have lost comparable amounts of uranium. (auth)

49941 A REAPPRAISAL OF THE DECAY CONSTANTS AND BRANCHING RATIO OF ^{40}K. Beckinsale, R. D. (Inst. of Geological Sciences, London); Gale, N. H. Earth Planet. Sci. Lett., 6: 289-94(July 1969).

The decay scheme and decay constants of ^{40}K are reviewed in the light of modern physical data, and the implications for geochronology are discussed. (auth)

49942 ISOTOPES OF URANIUM AND RADIUM IN INDIAN RIVERS. Bhat, Suman G.; Krishnaswamy, S. (Tata Inst. of Fundamental Research, Bombay). Proc. Indian Acad. Sci., Sect. A, No. 1, 1-17(July 1969).

The concentrations of dissolved uranium and radium isotopes have been determined in the waters of several Indian rivers. The concentration of ^{238}U was found to vary between 0.01 to 7.0 micrograms/liter, depending primarily on the terrain through which the river flows. From the available data on the activity ratios, $^{234}U/^{238}U$, concentration of ^{238}U in rivers and the amount of uranium depositing on the ocean floor, a material balance calculation has been attempted. This showed that, based on above measurements, the supply of U deposited in the sea by rivers was inadequate to explain the observed concentrations of ^{238}U and ^{234}U in the oceans. The ^{226}Ra concentration of river waters was found to be of the order of 0.1 dpm/liter (varying between 0.05 to 0.2 dpm/liter). The activity ratios, $^{228}Ra/^{226}Ra$ range between 1 and 4. This large variation is clearly related to the fact that the concentrations of the parent nuclides of ^{226}Ra and ^{228}Ra are different. The observed ratios were consistent with those expected from leaching of clays/soils; however, analogous to the situation in the case of U the observed concentrations of Ra isotopes in the oceans are too large to be explained by their influx by rivers. (auth)

Meteorology

Refer also to abstracts 49746, 49929, 50456, 50459, and 50462.

49943 (BNWL-1051(Pt.2), pp 82-4) SHORT-LIVED COSMIC-RAY-PRODUCED RADIONUCLIDES AS TRACERS OF ATMOSPHERIC PROCESSES. Young, J. A.; Wogman, N. A.; Thomas, C. W.; Perkins, R. W. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Radionuclides are produced continuously in the atmosphere by cosmic rays. Their production rates vary considerably with altitude and latitude but remain relatively constant with time. Following formation, these radionuclides quickly become attached to atmospheric aerosols and can thus serve as tracers of the subsequent behavior of these aerosols. The natural atmospheric aerosols are vital to rain and snow formation since water droplets or ice particles are formed by the condensation of water vapor on aerosol particles. Aerosol particles are also picked up by a water droplet or ice particle after nucleation while it is still in the cloud or falling below the cloud. Not much is known about the relative efficiencies of nucleation and post-nucleation scavenging of the aerosol particles. The problem is difficult to study in the laboratory or by the introduction of artificial aerosols such as silver iodide into the atmosphere, since scavenging mechanisms are very sensitive to the properties, including electrical charge, of the aerosol particle. It is difficult, if not impossible, to duplicate the natural atmospheric aerosol distribution in the laboratory. It has been recognized that radionuclides with half-lives of minutes to hours would be useful in studying atmospheric precipitation scavenging mechanisms since their half-lives are of the same order of magnitude as the time scale on which precipitation processes occur. Of particular interest are the short-lived cosmic-ray-produced radionuclides ^{38}Cl (37 min), and ^{39}Cl (55 min). (auth)

49944 (BNWL-1051(Pt.2), pp 85-91) CONCENTRATIONS OF AIRBORNE RADIONUCLIDES DURING 1968 AT POINT BARROW, ALASKA; RICHLAND, WASHINGTON; AND RIO DE JANEIRO, BRAZIL. Thomas, C. W. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The atmospheric concentrations of some 20 radionuclides were measured at ground level at Point Barrow, Alaska; Richland, Washington; and Rio de Janeiro, Brazil, during 1968 in a continuing study initiated in 1962. Nearly all radionuclide concentrations showed significant increases over the previous year, which reflect the high yield thermonuclear tests conducted by the Chinese in the northern hemisphere and the French in the southern hemisphere. In 1968, the shape of the annual spring concentration maximum measured at Point Barrow, Alaska, was notably different, showing a second peak in July. Rapid excursion of fresh nuclear debris from the southern hemisphere was measured in the northern hemisphere at Richland, Washington, and Point Barrow, Alaska. (auth)

49945 (BNWL-1051(Pt.2), pp 92-102) RADIONUCLIDE CONCENTRATIONS BETWEEN 5,000 AND 63,000 FEET IN 1967 AND 1968. Young, J. A.; Wogman, N. A.; Thomas, C. W. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Radionuclides are produced continuously in the atmosphere by cosmic rays. Their production rates vary considerably with latitude and altitude but remain relatively constant with time. Measurements were made of the atmospheric concentrations of the cosmic-ray-produced radionuclides ^{7}Be (53 d), ^{24}Na (15 hr), ^{38}Cl (37.3 min), and ^{39}Cl (55 min); the radon daughters ^{208}Tl and ^{214}Bi; and the nuclear-bomb-produced radionuclides. The ^{24}Na disintegration rate at 46°N increased approximately exponentially from 10^{-2} dpm/10^4 SCF at ground level to 25 dpm/10^4 SCF at 63,000 ft. The ^{38}Cl and ^{39}Cl disintegration rates at a given altitude were 7 to 10 times the ^{24}Na disintegration rate. At 60,000 ft the ^{24}Na disintegration rate increased from 6.5 dpm/10^4 SCF at the equator to 24 dpm/10^4 SCF at 60°N. The 53-day ^{7}Be half-life is long enough so that its atmospheric concentrations are considerably affected by air motions and deposition at the earth's surface. At 46°N the tropospheric ^{7}Be concentrations reached a maximum around June. In December of 1967 the ^{7}Be concentrations at 30,000 and 40,000 ft at 46°N increased sharply, presumably due to the transfer of radionuclides down to the low stratosphere in the winter. The French began a nuclear test series in the Pacific at 23°S on July 6, 1968. Tropospheric air samples collected from 35°N to 49°N on and after August 26, 1968, contained ^{140}Ba (12.8 d) from these tests. Maximum concentrations occurred at 40,000 ft. Barium-140 was not present in detectable quantities in the stratosphere at 60,000 ft from 35°N to 49°N. Presumably, the French debris was transported northward primarily in the upper troposphere where wind speeds are high. (auth)

49946 (BNWL-1051(Pt.2), pp 102-4) RADIONUCLIDE CONCENTRATIONS IN AIR AT GROUND LEVEL AT BARBADOS,

BRITISH WEST INDIES. Thomas, C. W.; Young, J. A.; Perkins, R. W.; Wogman, N. A. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Preliminary measurements of radionuclides in air were conducted at Barbados, British West Indies, in support of the oceanographic-meteorological experiment BOMEX. The intrusion of fresh fission debris from the southern hemispheric French nuclear tests was detected on August 22, 1968. The ground level concentrations of ^{7}Be were similar to those measured at Richland, Washington, at 46°N. (auth)

49947 (BNWL-1051(Pt.2), pp 104-8) THE TRANSFER OF AIRBORNE RADIONUCLIDES ACROSS THE SEA SURFACE AT 13°N, 58°W. Young, J. A. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Air filter samples were collected twice a day at 7, 25, and 76 ft above mean sea surface aboard the USC&GSS Discoverer stationed east of Barbados, British West Indies, at 13°N during August 1968. Beryllium-7 (53 d), $^{95}Zr-Nb$ (65 d), ^{103}Ru (40 d), ^{106}Ru (1.0 yr), ^{137}Cs (30 yr), and ^{140}Ba (12.8 d) concentrations were determined in these samples. The radionuclide concentrations increased significantly from the 7- to the 25-foot sample, but averaged the same in the 25- and 76-foot samples. The concentration increase was greater for samples collected during the day than for those collected during the night. Rain samples and seawater samples down to 210 m were also collected aboard the Discoverer. (auth)

49948 (BNWL-1051(Pt.2), pp 108-10) FRACTIONATION OF RADIONUCLIDES DURING NUCLEAR TESTING. Silker, W. B.; Thomas, C. W. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The fractionation of fission products was examined with respect to the member of the isobar present at the time of particulate formation. (auth)

49949 (BNWL-1051(Pt.2), pp 111-16) POSSIBLE INTRUSION OF FRENCH NUCLEAR TEST DEBRIS INTO THE NORTHERN HEMISPHERE. Thomas, C. W.; Young, J. A.; Perkins, R. W.; Wogman, N. A. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Fresh fission product debris was measured in the northern hemisphere at several locations and altitudes shortly after the French initiated their 1968 nuclear test series. Concentration ratios of the radionuclides indicated a detonation date that coincided with these tests. If this debris was indeed due to French southern hemispheric testing, a mean latitudinal northern transport rate of 1°-2° lat per day was evident. The French culminated the test series by detonating two high-yield hydrogen devices, placing much of the debris into stratospheric levels centered around 5° and 10°S lat. (auth)

49950 (CU-2493-10(App.D)) LAKE TAHOE FALLOUT STUDY. Simpson, H. James (Columbia Univ., Palisades, N. Y. Lamont-Doherty Geological Observatory). Sept. 30, 1969. Contract AT(30-1)-2493. 28p. Dep. CFSTI.

Lake Tahoe waters were monitored in 1969 for the purpose of estimating the total fallout deposition and ^{137}Cs, ^{90}Sr, and tritium contents in the lake. The mechanisms by which these isotopic contents reach the lake waters, such as precipitation and runoff from soils, were studied. The results were compared with similar estimates for Crater Lake made in 1967. (L.C.L.)

49951 (EUR-4246) RESULTS OF ENVIRONMENTAL RADIOACTIVITY MEASUREMENTS IN THE COMMUNITY COUNTRIES IN 1967: AIR, FALLOUT, AND WATER. (European Communities, Luxembourg. Commission). 1968. 68p. (In several languages). Dep. CFSTI (U. S. Sales Only).

Results of the measurements carried out in 1967 by the member States at the environmental radioactivity monitoring stations are reported, together with certain data obtained at Euratom's Joint Research Centre, Ispra. Measurements were made of radioactivity in the air at ground level, in fallout, and in water. Most of these measurements relate to total beta radioactivity. The measurement results for certain specific radionuclides are also given as well as the amount of precipitation observed at fallout sampling stations. Graphs are presented to show the pattern followed throughout the year, a comparison being drawn with the development over the years 1962, 1963, 1964, 1965, and 1966 as well as with the situation in 1967 in the United States and Canada. (auth)

49952 (UCRL-71837) APPLICATIONS OF A PHOTOMICROSCOPIC TECHNIQUE TO THE PARTICLE SIZE ANALYSIS OF A SAMPLE FROM A NUCLEAR CRATERING CLOUD. Rynders, Gerald F. (California Univ., Livermore. Lawrence Radiation Lab.). Sept. 4, 1969. 24p. (CONF-690920-3). Dep. CFSTI.

From 2nd Annual Technical Meeting of International Metallographic Society, San Francisco, Calif.

A particle size distribution was obtained for a sample, collected by an aircraft from a cloud resulting from a nuclear cratering experiment. Because of the large size range of particles encountered in the initial sample, a sedimentation technique was employed to reduce the range in a particular counting field. A photomicroscopic technique in conjunction with a Zeiss Particle Size Analyzer was used. The distribution obtained, while essentially log-normal, could also be fitted to an exponential relationship. A number of subpopulations were observed which would be expected to have separate distributions although these were not evaluated. Errors of restricted sample size were attached to the final values. Recommendations are presented for further improvement of such analysis. (auth)

49953 RADIOACTIVE ISOTOPES AS AIR MASS INDICATORS. II. PRODUCTION OF ^{33}P. Hartwig, S.; Sittkus, A. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Z. Naturforsch., 24a: 908-11(June 1969). (In German).

Concentration measurements of the isotopes ^{7}Be, ^{32}P and ^{33}P in ground-level air give rise to false conclusions about airmass exchange in the atmosphere if the measured ^{32}P data are used as a means of characterization. The reason for this lies in too low a production rate for ^{33}P. A yield of 5.1×10^{-2} (±10%) ^{33}P per star was determined. Within the accuracy in measurement the yields for ^{33}P and ^{32}P were equal. (auth)

49954 RESULTS OF INVESTIGATIONS OF NUCLEAR FALLOUT OVER THE TERRITORY OF USSR. Ramzaev, P. V.; Nevstrueva, M. A.; Il'in, L. A.; Prokof'ev, O. N.; Popov, D. K.; Shvydko, N. S.; Shapiro, E. L.; Perova, A. A.; Shamov, V. P. At. Energ. (USSR), 26: 62-4(Jan. 1969). (In Russian).

Geographic and socioeconomic factors were considered in studies of global fallout and the aspects of peaceful applications of nuclear energy. The studies from 1959 to 1967, in several northern regions in Soviet Russia indicated that even at low fallout levels the concentration of radioactive isotopes may result in internal absorption in various groups of the population, higher by an order of one or two than in the population in central regions. Tabulated data are given on the concentration of ^{90}Sr and ^{137}Cs in the biosphere during surface contamination including: grass, grain, potatoes, lichens, milk, venison, and fish. Data are also given on the isotope level in the organs of children (3 to 5 years old), women, men, and deer breeders of the examined region. (R.V.J.)

Mineralogy and Exploration

49955 RECONNAISSANCE RADIOMETRIC SURVEY IN THE NORTHERN PART OF MT. RYOZEN AREA, ON THE BOUNDARY OF FUKUSHIMA AND MIYAGI PREFECTURES. Obi, Itsuaki (Geological Survey of Japan, Kawasaki); Koseki, Koji. Chishitsu Chosasho Geppo, 20: 197-202(Mar. 1969). (In Japanese).

The area between Sendai and Jōban is composed of tertiary formations. The basement rocks of the area are granitic and overlain by the Neogene sediments called the Ryōzen and Yanagawa formations. At the Ōuchi coal mine in Miyagi prefecture, occupying the eastern suburbs of the area, radioactive anomalies were found in the tertiary coal seams in 1961. The similar geologic environment and horizon are observed through the Ōuchi and Ryōzen areas. A weak radioactive anomaly was found at Shirane (Yanagawa-chō) in arkose sandstone which belongs to the basal part of the Ryōzen formation, showing 7 to 8 times of natural background counts. Chemical analysis showed that the specimen contained up to 0.012% U_3O_8. No uraniferous ore mineral has been identified in the samples analyzed. (NSA of Japan)

49956 URANIUM RESERVES AND RESOURCES: PLENTY FOR POWER? Witzke, R. L.; Smith, E. E.; Bach, J. H. Elec. Light Power (Boston), 47: 154-6(May 1969).

Reserves are defined as uranium that can be developed and delivered on a short term basis; resources represent a discovery potential and are applicable to long-term estimates. According to AEC estimates, the known reserves will satisfy domestic requirements through 1977. It was concluded that adequate uranium is available for short-term requirements. To evaluate the reserves for the intermediate term, the probable results of exploration programs to be conducted during the next few years are considered. The long-term requirements consider only known uranium bearing geologic formations as a minimum and reserves of various minerals as a function of their crustal abundance as a maximum consideration. (J.C.W.)

49957 SOURCE ROCKS OF MIOCENE BEDDED-TYPE URANIFEROUS DEPOSITS IN NORTHERN MIYOSHI DISTRICT AND GENESIS OF URANIUM ANOMALIES AT MYOGA, SHOBARA CITY, HIROSHIMA PREFECTURE, JAPAN. Ishihara, Shunso;

Komura, Kojiro (Geological Survey of Japan, Kawasaki). Chishitsu Chosasho Geppo, 20: 161-72(Mar. 1969). (In Japanese).

A new uranium deposit, located in the northern parts of Hiroshima prefecture, western Honshu, is a Miocene bedded-type. Japanese uranium deposits of this type generally overlie Laramide granitic rocks, which are usually high in trace amounts of uranium. Pre-Miocene rocks are, in order of generalized sequence, composed of late Cretaceous andesite and its pyroclastic rocks (1%), rhyolitic (welded) tuff (52%) interbedded with sandstone and shale, granite porphyry (8%), quartz diorite to granodiorite (9%), and biotite granite to leucogranite (14%). Miocene sediments fill small basins developed in all of the above mentioned rocks, but uranium occurrences are limited in the basal parts of the sediments deposited above a biotite granite mass — namely called Konan pluton. The granite is exposed in a circular form with the diameter of about 6 km. The rock is dominant in vugs and cavities and shows micrographic textures in many places. Compositionally, the rock is slightly high in alkali feldspars and poor in quartz in comparison with similar granites in the Inner Zone of Southwest Japan. These would indicate relatively high contents of uranium and thorium in this rock. However, the rock showed averages of only 2.4 ppM U and 10.7 ppM Th; while those of other granite masses in the studied area were 4.0 ppM U and 18.5 ppM Th. The Konan pluton contains hydrothermal alteration minerals in almost all places. It is feasible to assume that some of them, especially most of clay minerals would have been formed during sedimentation of the Miocene beds, because the pluton could have been least resistant among the various igneous rocks in the weathering stage. Most parts of the pluton show basin topography at present surface. Low values of uranium and thorium would not reveal the initial contents of the Konan pluton. If so, the uranium value would have been as high as for example 4 to 6 ppM, then leached out during the sedimentation cycle. The leached uranium was circulated in porous beds of the Miocene sediments and enriched in and near the beds. Uranium anomalies at Myoga occur in altered rhyolitic (welded) tuff of about 10 meters beneath Miocene mudstone. The uranium was originally brought with hydrothermal alteration such as chloritization and sericitization in the rhyolitic tuff. The uranium was removed by argillization during development of Miocene basin, and then scattered around the original alteration bands. The element is now absorbed in clay minerals. (auth) (NSA of Japan)

49958 PROSPECTING WITH NEUTRONS. Wylie, A. W.; Eisler, P. L. (Commonwealth Scientific and Industrial Research Organization, Melbourne). Philips Tech. Rev., 30: 97-105(1969).

Bore-hole logging by nuclear techniques is a very promising alternative for the expensive method of core drilling in the search for minerals. The procedure discussed consists in lowering down the drill hole a source of fast neutrons which excite gamma radiation from the material of the wall of the hole. This radiation is detected by a scintillator crystal with photomultiplier mounted on top of the neutron source and suitably shielded from the direct beam of source radiation. From the pulses transmitted to the surface the energy spectrum of the radiation is derived by a multichannel pulse-height analyzer and recorded during the lowering operation. A discussion of the nuclear processes involved and the equipment used shows the importance of using a pulsable neutron source. Two types of sealed neutron generator tubes are suitable for the purpose. The problem of deriving the relevant information from the radiations detected is considered in some detail and experimental means for investigating this problem by simulating possible bore-hole situations are described. (auth)

49959 MARTHOZITE, A NEW MINERAL SPECIES; A HYDRATED COPPER URANYL SELENITE. Cesbron, Fabien (Faculte des Sciences, Paris); Oosterbosch, R.; Pierrot, Roland. Bull. Soc. Fr. Miner. Crist., 92: 278-83(May-June 1969). (In French).

Marthozite occurs in the oxidation zone of the Cu–Co deposit at Musonoi, Katanga. Crystals are orthorhombic, space group Pnma or $Pn2_1a$, with a = 16.40, b = 17.20 and c = 6.98 Å. The strongest lines of the x-ray powder diagram are: 8.65 ms (020); 8.23 vvs (200); 4.44 ms (031); 3.50 s (002); 3.42 ms (102); 3.22 vs (022); 3.09 vvs (051); 3.02 s (431,222); 2.900 vs (251). Analysis gave: SeO_2: 23.7; UO_3: 60.5; CuO: 4.3; H_2O: 10.7; sum: 99.2%. These correspond to the formula $Cu(UO_2)_4(SeO_3)_4(OH)_2 10H_2O$ with Z = 3 and d = 4.4 g/cm³. This formula is however unsatisfactory, because the symmetry requires an even number of the Cu atoms in the unit cell. In the place of $Cu_3(UO_2)_{12}(SeO_3)_{12}(OH)_6 30H_2O$ the content of unit cell would be $Cu_4(UO_2)_{12}(SeO_3)_{12}(OH_8)28H_2O$. Marthozite dehydrates at room temperature to a meta phase orthorhombic with a = 15.80, b = 17.20, and c = 6.98 Å. After heating at 70°C a twinned monoclinic phase is found at room temperature. Crystals, yellow-green, are flattened on (100) and dominant forms are (100), (011), (010), and (2$\bar{3}$0). Cleavages (100) is perfect and (010) imperfect. Marthozite is optically biaxial negative with 2V = 39°. (auth)

Oceanography

Refer also to abstracts 49743, 49947, 50101, and 50404.

49960 (BNWL-1051(Pt.2), pp 27-32) SURFACE CONCENTRATIONS OF RADIONUCLIDES IN THE NORTH PACIFIC OCEAN. Silker, W. B. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Samples were taken from the surface and at a depth of 25 m in the North Pacific Ocean off the coasts of Central and North America. Beryllium-7 concentrations in surface water were 600 to 700 $d/m/10^3$ liters in equatorial waters and 50 to 100 $d/m/10^3$ liters between 13° and 40°N lat. Fission-product radionuclides exhibited two regions of high concentrations, one between 12°30′ and 15°N and the other between 25° and 30°N. The ratio of radionuclide concentrations at surface and at 25 m depths indicated relatively slow mixing rates in this water column. (auth)

49961 (BNWL-1051(Pt.2), pp 32-5) RADIONUCLIDE CONCENTRATIONS IN THE ATLANTIC OCEAN NEAR BARBADOS. Silker, W. B.; Rieck, H. G. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

A preliminary study was conducted to determine the concentrations of several natural and artificial radionuclides in the Atlantic Ocean east of Barbados, W. I. Surface concentrations were constant throughout the sampling period, except for the introduction of fresh fission products from French nuclear testing. Vertical transport of radionuclides was inhibited by a strong thermocline. Greater than 95% of the ^{7}Be and $^{95}Zr-Nb$ was contained in the top 100 m and greater than 90% of the ^{106}Ru and ^{144}Ce resided above 200 m depths. (auth)

49962 (BNWL-1051(Pt.2), pp 36-9) ^{51}Cr FROM THE COLUMBIA RIVER IN OCEAN WATER OFF THE WEST COAST DURING NOVEMBER 1968. Perkins, R. W. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The ^{51}Cr concentration in the Pacific Ocean was characterized on a line extending from California waters to the Strait of Juan de Fuca and at distances of about 25 to 60 km offshore. Maximum concentrations on this sampling line were observed at about 170 km north of the mouth of the Columbia River. The sample collection employed a new sorption technique that required no chemical separations but allowed identification of Columbia River water at dilutions of up to 300,000-fold. The applicability of the sorption method for sampling while underway at sea and the important potential of these measurements together with salinity measurements were demonstrated. (auth)

49963 (BNWL-1051(Pt.2), pp 40-3) RADIONUCLIDE CONCENTRATIONS IN NORTHEAST PACIFIC OCEAN SEDIMENTS IN THE VICINITY OF THE COLUMBIA RIVER ESTUARY. Robertson, D. E.; Forster, W. O. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The radionuclides ^{40}K, ^{46}Sc, ^{51}Cr, ^{54}Mn, ^{60}Co, ^{65}Zn, ^{124}Sb, $^{140}Ba-La$, ^{226}Ra, and ^{228}Th were measured in 15 Columbia River estuarine and adjacent Pacific Ocean sediments. Potassium-40, ^{46}Sc, ^{60}Co, ^{65}Zn, ^{226}Ra, and ^{228}Th were present in all samples, while ^{51}Cr, ^{124}Sb, and $^{140}Ba-La$ were present in only one atypical sample collected about five miles straight out from the mouth of the river. Concentration gradients of the radionuclides ^{46}Sc, ^{60}Co, and ^{65}Zn and the activity ratios of $^{46}Sc/^{65}Zn$ and $^{65}Zn/^{60}Co$ indicated that sedimentary material had moved mainly northward at a velocity of 0.1 to 0.5 cm/sec. The naturally occurring radionuclide ^{228}Th appeared to be a potentially valuable tracer of the distribution and movement of the suspended load of the Columbia River as it enters the ocean. (auth)

49964 (BNWL-1051(Pt.2), pp 50-1) PARTICULATE Pb, ^{210}Pb, AND ^{210}Po IN THE ATLANTIC OCEAN. Langford, J. C. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Particulates Pb, ^{210}Pb, and ^{210}Po were measured in Atlantic Ocean surface samples collected from various locations between the Bahama Islands and Sierra Leone, Africa. Particulate ^{210}Pb and ^{210}Po were in equilibrium. The particulate Pb concentration decreased ninefold from 25°38′N lat 72°20′W long. to 24°48′N lat 59°20′W long., then decreased only 20% to 5°48′N lat 16°35′W long. (auth)

49965 (BNWL-1051(Pt.2), pp 63-8) ^{55}Fe IN BERING AND NORTH AMERICAN PACIFIC SALMON. Jenkins, C. E.; Langford, J. C. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Iron-55 concentrations in Pacific salmon are generally decreasing by a yearly factor of 2 to 4 in a given location and ninefold from Kotzebue, Alaska, to Sacramento, California. The concentra-

tions of Fe in salmon are nearly species-independent and may offer a method for the determination of an integrated ^{55}Fe concentration in seawater from a given locale. (auth)

49966 (BNWL-1051(Pt.2), pp 69-72) ^{55}Fe CONCENTRATIONS IN COLUMBIA RIVER ESTUARINE AND PACIFIC OCEAN MARINE ORGANISMS. Jenkins, C. E.; Langford, J. C.; Forster, W. O. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The uptake and transfer of ^{55}Fe and stable Fe by surface marine and Columbia River estuary organisms appear to be a function of distance from the river mouth. Stable Fe decreased with distance in all but the bottom-feeding organisms. Pacific Coast salmon have ^{55}Fe concentrations and specific activities 10- to 100-fold higher than Columbia River estuarine and marine organisms. (auth)

49967 (RLO-1725-150) COLUMBIA RIVER EFFECTS IN THE NORTHEAST PACIFIC. Annual Progress Report, June 1968–May 1969. Barnes, Clifford A. (Washington Univ., Seattle. Dept. of Oceanography). July 11, 1969. Contract AT(45-1)-1725. 30p. Dep. CFSTI.

A summary is given of the biological, chemical, geological-geochemical-geophysical, and physical aspects of the Columbia River system distributions affecting the Northeast Pacific Ocean. The occurrence, distribution, and properties of the relatively deep high-chlorophyll layer that underlies the Columbia River plume in summer have been investigated. Evidence that sedimentary materials on the continental shelf contributed by the Columbia River are moving northward toward the Strait of Juan de Fuca and ponding in part on the shelf has been established. Improved analysis has been made of the distribution of the properties and processes in the stystem comprising the river, its estuary, and the near ocean. Segments of the phytoplankton, zooplankton, and bottom populations important to the local ecology have been described, and this will allow the tracing and understanding of the paths traversed by radionuclides in the organic and physical system. (J.C.W.)

49968 OBJECTIVE ANALYSIS OF ^{90}Sr CONCENTRATION FIELD IN ATLANTIC OCEAN. Belyaev, V. I.; Doronin, I. F.; Ermolenko, A. I.; Ivanova, T. M.; Nelepo, B. A.; Timchenko, I. E. (Inst. of Marine Hydrophysics, Tashkent). Izv. Akad. Nauk SSSR, Fiz. Atmos. Okeana, 5: 860-7(Aug. 1969). (In Russian).

A chart of surface ^{90}Sr concentration in the Atlantic Ocean was plotted by an objective analysis method from data acquired during 1962 to 1964. (auth)

Seismology

Refer also to abstracts 49974 and 49976.

49969 (CEA-R-3767) SPECTRAL CONTENT OF SEISMIC MOVEMENTS PRODUCED BY UNDERGROUND NUCLEAR EXPLOSIONS. Albaret, Agnes; Duclaux Francoise (Commissariat a l'Energie Atomique, Bruyeres-le-Chatel (France). Centre d'Etudes). June 1969. 27p. (In French). Dep. CFSTI (U. S. Sales Only).

A summary is given of available experimental and theoretical data concerning the spectral content of seismic movements. Experiments carried out during French nuclear explosions in the Sahara and the results obtained on the volume waves are described. The results are compared with certain American results. A new method for studying the amplitude spectra is discussed. It shows that the amount of low frequencies in the spectrum increases with the power of the explosions and decreases with the distance to the zero point and with the filtering effect of the weathered zone. A calculation is made of the low cut-off ground filter, which results in a better representation of the initial seismic phenomenon. (auth)

49970 LONG-PERIOD SIGNAL PROCESSING RESULTS FOR THE LARGE APERTURE SEISMIC ARRAY. Capon, J.; Greenfield, R. J.; Lacoss, R. T. (Massachusetts Inst. of Tech., Lexington). Geophysics, 34: 305-29(June 1969).

The results of off-line signal processing experiments are presented for long-period (LP) data obtained from the Large Aperture Seismic Array (LASA) in eastern Montana. It was found that the most useful LP phase for discriminating between earthquakes and underground nuclear explosions is the Rayleigh surface wave. This wave provides the information necessary to compute the surface-wave magnitude, which in conjunction with the body-wave magnitude, proved to be a discriminant leading to a clear separation between the 2 events. In addition, this discriminant can be applied at lower magnitude levels than any which are based on such LP body-wave phases as P and S waves. The LPZ sensors were found to have about 10 db lower noise level than the EW, NS components. Thus, for the purpose of seismic discrimination, it was only the LP Rayleigh surface waves and the LPZ sensors which were important. This discriminant was measured for events from 4 tectonic regions of the earth, and showed that 60 and 100% detectability of surface waves for natural seismic events from the Central Asian-Kurile Islands-Kamchatka region occurs at about LASA body-wave magnitudes 4.5 and 4.9, respectively. (BBB)

ENGINEERING

Nuclear Explosions

Refer also to abstracts 49946, 49952, 49954, 49969, and 50460.

49971 (AD-689110) ON THE INFLUENCE OF AN EXTERNAL MAGNETIC FIELD ON AN MHD MODEL OF A NUCLEAR EXPLOSION. Jen, N. C.; Lutzky, M. (Naval Ordnance Lab., White Oak, Md.). Feb. 7, 1969. 27p. (NOLTR-68-206). CFSTI.

A 2-D, Lagrangian, artificial-viscosity type computer code is used to calculate the effects of an initially constant magnetic field on an MHD model of a nuclear explosion. In this model, both the fireball and surrounding medium are fluids with infinite electrical conductivity. It was found that a sufficiently strong magnetic field will elongate the fireball in the direction of the field and increase the shock speed perpendicular to the field. The methods can be extended to treat more realistic cases, such as fluids of finite conductivity and plasmas. (auth) (USGRDR)

49972 (AD-690208) GROUND MOTION PREDICTIONS FOR NUCLEAR ATTACK AREA STUDIES. Murphy, H. L. (Stanford Research Inst., Menlo Park, Calif.). May 1967. Contract DAHC20-67-C-0136. 140p. CFSTI.

An analytical discussion is given on technical data found in a broad literature search and considered potentially useful in making preliminary predictions of the ground motions that might be expected following a nuclear detonation. The predictions are based on sparse geological and soils data. The technical data were used under assumed nuclear yields and burst points (air and surface), with one burst at or near each of several U.S. cities. The techniques used and results obtained are discussed. (auth) (USGRDR)

49973 (AD-690483) SOME RADIOCHEMICAL AND PHYSICAL MEASUREMENTS OF DEBRIS FROM AN UNDERGROUND NUCLEAR DETONATION. Final Report. Report on Project SEDAN, Nevada Test Site, July 6, 1962. Lane, W. B. (Naval Radiological Defense Lab., San Francisco, Calif.). Jan. 7, 1964. 126p. (PNE-229-F). CFSTI.

Fallout samples were collected from 2600 feet to 19,000 feet from ground zero in order to determine the mass per unit area, gamma activity per unit area, particle size distribution, and specific activity vs. particle size of the fallout. Studies were made to determine the gamma decay rate and spectra of the samples, to perform leaching and exchange studies on the radioactive debris, to measure the release of gaseous fission product iodine, and to determine the radiochemical composition of the fallout particulate. (auth) (USGRDR)

49974 (CEA-R-3750) GENERAL PHENOMENOLOGY OF UNDERGROUND NUCLEAR EXPLOSIONS. Derlich, Serge; Supiot, Francis (Commissariat a l'Energie Atomique, Bruyeres-le-Chatel (France). Centre d'Etudes). Aug. 1969. 33p. (In French). Dep. CFSTI (U. S. Sales Only).

An essentially qualitative description is given of the phenomena related to underground nuclear explosions (explosion of a single unit, of several units in line, and simultaneous explosions). The phenomena that are common to contained explosions and to explosions forming craters (formation and propagation of a shock-wave causing the vaporization, the fusion and the fracturing of the medium) are described. The phenomena related to contained explosions (formation of a cavity with a chimney) are discussed. The phenomenology of test explosions which form craters is outlined with emphasis on the mechanism of formation and the different types of craters as a function of explosion depth and nature of the ground. The aerial phenomena connected with crater-forming explosions such as shock wave in the air, focussing at a large distance, and dust clouds are also considered. (auth)

49975 (CEA-R-3762(1)) STUDY METHODS FOR THE DRILLINGS AROUND THE UNDERGROUND NUCLEAR EXPLOSIONS IN THE SAHARA. PART I. STUDY OF ROCK SAMPLES. Derlich, Serge (Commissariat a l'Energie Atomique, Bruyers-le-Chatel (France). Centre d'Etudes). Aug. 1969. 15p. (In French). Dep. CFSTI (U. S. Sales Only).

An examination of the effects produced on rocks by an underground nuclear explosion requires particular means of exploration, which are described. Special attention is given to the equipment used in connection with the French nuclear tests in the Sahara. The drilling methods used (rotary and turbodrilling) were adapted to the particular conditions of the sampling program, to the radioactivity, and to the temperature in the region of the explosion. The chemical and mechanical transformations of the rock samples were determined. An examination of the core obtained from the drilling, together with a knowledge of the drilling parameters (depth of the probe, sample recovery, etc. . .), made it possible to study the extent and the characteristics of the zones which were damaged to different degrees according to their distance from the zero point: cavity, strongly powdered zone, fractured zone, chimney, zones containing high stresses leading to a particular type of fracture of the cores. The problems connected with the interpretation of the results are also presented. (auth)

49976 (NVO-1163-180) PREDICTIONS OF SEISMIC MOTION AND CLOSE-IN EFFECTS: RULISON EVENT. Weetman, B. G.; Berry, R. H.; Davis, L. L.; deCaprariis, P. P.; Hays, W. W.; Mueller, R. A.; Murphy, J. R.; Orphal, D. L.; Spiker, C. T. (Environmental Research Corp., Alexandria, Va.). Aug. 1969. Contract AT(29-2)-1163. 70p. (PNE-R-5). Dep. CFSTI.

The development of methods for predicting seismic motion and close-in effects for the Rulison event are discussed, with emphasis on: predictions of peak particle motion for selected locations; predictions of distances to peak particle motions of 0.1 g and 0.001 g (Accelerations); predicted Pseudo-Relative Velocity (PSRV) Spectra at selected stations; geologic environment; predictions of cavity, cracking and gamma-radioactivity radii; and predictions of chimney height and surface spalling. (auth)

49977 (UCRL-71901) PLANNED APPLICATIONS OF PEACEFUL NUCLEAR EXPLOSIVES. Werth, Glenn C. (California Univ., Livermore. Lawrence Radiation Lab.). Aug. 13, 1969. 47p. (CONF-690303-4). Dep. CFSTI.

From Symposium on the Biological Implications of the Nuclear Age, Livermore, Calif.

The basic objective of the Plowshare Program at the Lawrence Radiation Laboratory is to explore possible industrial applications of nuclear explosives. The approach is through the development of an understanding of the effects of nuclear explosions on the environment, including the fracturing and movement of the rock, the disposition of the radioactivity, the effects of seismic waves on structure, and the effects of the use of these explosives on man. Potential applications of nuclear explosives are conveniently defined by the depth of emplacement of the explosive. Deep emplacement produces the nuclear chimney, an underground cavity surrounded by fractured rock not extending to the surface. A promising application is the stimulation of gas production by breaking up rock in gas-tight reservoirs. The Gasbuggy experiment demonstrated the feasibility of the idea, and several other projects are in various-stages of planning or preparation. Other possible applications include the breaking up of ore bodies for leaching, the in situ retorting of oil from shales, and terminal gas storage. Intermediate emplacement produces the retarc, a cone of fractured rock extending to the surface. Proposed applications include the breaking up of ore bodies near the surface for leaching, the production of aggregate, and dam-building. Shallow emplacement produces the crater, and a row array of such explosives has been demonstrated to produce a ditch. Applications include the construction of harbors and canals, including the proposed sea-level Panama Canal project now under study by the Atomic Energy Commission. One important aspect of the Plowshare Program is the development of testing experience leading to the development of a capability to predict the effects of nuclear explosions under a variety of conditions. Through such work commercial application of nuclear explosives, fully responsive to the protection of public health and safety, is anticipated. (auth)

49978 NUCLEAR BLAST FOR W. A. HARBOUR. Aust. Civil Eng., 10: 34-5(Mar. 1969).

The U. S. Government has agreed to participate in a study of the technical and economic feasibility of using nuclear explosives to excavate a new deep water harbor at Cape Keraudren on the northwest coast of Australia, to serve a number of iron-ore projects in the Mount Goldsworthy-Nimingarra area. The site has the advantage of being remote from population and from buildings likely to be affected by seismic shock. It is estimated that five nuclear explosions of 200 kilotons each, fired simultaneously are required to produce a harbor 6,000 ft long, 1,300 to 1,600 ft wide and 300 to 400 ft deep. This will accommodate ships of up to approximately 150,000 dwt. The decision to conduct the feasibility study resulted from a survey, undertaken by a team of the U.S.A.E.C.'s Plowshare program at the invitation of the Australian Atomic Energy Commission. Other possible projects investigated by the team include creation of water storages and completely contained underground explosions for mining purposes. (auth)

49979 UNDERGROUND NUCLEAR EXPLOSIONS AND THE CONTROL OF EARTHQUAKES. Emiliani, Cesare; Harrison,

Christopher G. A.; Swanson, Mary (Univ. of Miami, Florida). Science, 165: 1255-6(Sept. 19, 1969).

Data comparison studies showed that underground nuclear explosions trigger significant earthquake activity for at least 32 hours afterward and to distances up to at least 860 kilometers. The proposed Amchitka test may be used to study the feasibility of employing high-yield underground nuclear explosions to release stresses accumulating in the lithosphere. Periodical explosions along active fault zones may be used to prevent disastrous earthquakes. (auth)

49980 DETECTION OF ELECTROMAGNETIC RADIATION FROM NUCLEAR EXPLOSIONS. Cotterman, Robert W. (to International Telephone and Telegraph Corp.). U. S. Patent 3,467,826. Filed Oct. 6, 1964.

A design is given of equipment for the detection of early electromagnetic radiation engendered by nuclear explosions. Radiation occurring at radiofrequencies for periods measured in nanoseconds is detected and proportional control signals are made available for operation of blast-closure devices and remote alarm indicators. (Offic. Gaz.)

49981 POSSIBILITIES FOR PEACEFUL NUCLEAR EXPLOSIVES. Int. At. Energy Agency Bull., 11: No. 3, 3-12 (1969).

Information presently available on the peaceful uses of nuclear explosives is summarized. What happens in an underground nuclear explosion is reviewed and discussed. Next, uses are considered and current knowledge summarized. It was concluded that it will take at least five years to develop and exchange all the information that will be necessary to undertake even the most straightforward projects, and that there will only have been a few such completed by 1980. (J.C.W.)

49982 SOME RESULTS OF GASBUGGY. Int. At. Energy Bull., 11: No. 3, 13-15(1969).

A brief review is given on the object and results obtained from Project Gasbuggy. It is stated that the results support present ideas that contained explosions may be considered as a possibility for the recovery of natural resources. (J.C.W.)

49983 NUCLEAR EXCAVATION: THEORY AND APPLICATIONS. Knox, Joseph B. (Univ. of California, Livermore). Nucl. Appl. Technol., 7: 189-31(Sept. 1969).

Recent and significant technical contributions to nuclear cratering technology are summarized. These include: a better understanding of the effects of improved explosive design on radioactivity in fallout patterns; methods for predicting close-in gamma exposure patterns and extended time airborne isotopic concentrations; new information on seismic propagation and blast effects; and data on cratering mechanics. Experimental data were obtained from Plowshare Project events such as the high energy explosion Scooter, and the nuclear explosions Danny Boy, Sulky, Cabriolet, and Buggy. The specific cratering applications discussed include: aggregate production; retarcs for in-situ leaching of near-surface ore deposits; harbor excavation; dam and water reservoir construction; and overburden removal for mining. The nuclear effects associated with nuclear excavation of a harbor of useful size is presented in light of recent studies of fallout effects, radioiodine deposition, air blast, and seismic motion, and provides a basis for evaluating these effects in other nuclear cratering applications. Future applied research necessary for advancing the state of Plowshare technology is outlined. (L.C.L.)

49984 CORPS OF ENGINEERS NUCLEAR CONSTRUCTION RESEARCH PROGRAM. Day, Walter C. (Army Engineer Nuclear Cratering Group, Livermore, Calif.). Nucl. Appl. Technol., 7: 253-68(Sept. 1969).

Since 1962 the Nuclear Cratering Group (NCG) of the U. S. Army Corps of Engineers has worked with the USAEC to develop the basic technology necessary for using nuclear cratering in large-scale construction projects. The NCG program activities include: cratering calibration of differing geologic media and testing of techniques designed to provide a desired crater geometry with chemical high explosive detonations; joint planning of, and technical participation in, AEC nuclear excavation experiments; development of pertinent data on the engineering properties of nuclear craters; development of civil works nuclear construction technology; accomplishment of engineering studies of nuclear construction feasibility; and execution of joint CE/AEC civil works nuclear construction experiments. Work to date in each of these activities is summarized, and data from cratering experiments in the Plowshare Program, using both chemical high-explosives and nuclear explosives are presented. (L.C.L.)

49985 A REVIEW OF TEN YEARS OF HIGH EXPLOSIVE CRATERING RESEARCH AT SANDIA LABORATORY. Vortman, Luke J. (Sandia Lab., Albuquerque, N. Mex.). Nucl. Appl. Technol., 7: 269-304(Sept. 1969).

Ten years of cratering research at Sandia Laboratory are reviewed and the results of this work related to the development of explosive excavation technology are described. Single-charge experiments gave empirical relationships between crater dimensions and energy release, burial depth, and medium. Energy release spanned the greatest range in desert alluvium, from 250 to 1,000,000 lbs. of explosive. Dimension depth-of-burst curves were established for two kinds of alluvium, for dry-lake playa, for tuff, and basalt rock. Dimension depth-of-burst curves and relations between crater dimensions and energy release also were established for continuous line charges in dry lake playa. Experiments with row charges provided basic information for optimizing row-charge detonations in level terrain. Investigations then were extended to terrain with a single elevation change and later to terrain with more typical variations. Special canal-related problems included how best to excavate through high-mountain regions with small charges detonated one at a time for use when safety considerations did not permit the more efficient detonation of larger charges in rows. Excavation in two vertical stages was also examined, with the finding that, to be effective, a crater from the first stage must be wide enough not to unduly restrict ejection of material from the second. Using parallel rows of explosives, it was found it is more effective to detonate parallel rows one at a time rather than to detonate two or three parallel rows simultaneously. The possible use of explosives for removing overburden for ore bodies was examined using, in addition to parallel rows, four and five charge square arrays using optimum combinations of spacing and burial depth these arrays removed three times more overborden than a single charge of comparable energy at the same depth. (auth)

49986 NUCLEAR EXCAVATION DESIGN OF A TRANS-ISTHMIAN SEA-LEVEL CANAL. Hughes, Bernaid C. Nucl. Appl. Technol., 7: 305-27(Sept. 1969).

An up-to-date analysis of the application of nuclear excavation technology to the design of a sea-level canal connecting the Atlantic and Pacific Oceans is presented. Consideration is given to use of nuclear methods in the construction of a sea-level canal through the Darien region of Panama (Route 17) and the Atrato-Truando region of northwest Colombia (Route 25). The site data required for a comprehensive nuclear excavation design analysis of a proposed sea-level alinement includes information pertaining to site topography, geology, hydrography, hydrology, meteorology, seismic propagation characteristics, bio-environmental conditions, and medico-ecology. These data are being used, together with data pertaining to nuclear explosive characteristics, cratering characteristics of pertinent geologic media, nuclear cratering detonation effects and channel design criteria, to develop an engineering-safety-cost analysis which is the basis for the nuclear excavation design. The results of geologic investigations to date along with 46-mile Route 17 alinement indicate that ~20 miles of the alinement through the Chucunaque Valley encounters a weak saturated clay shale while the balance of the excavation would be through relatively competent rock. In view of the unfavorable long-term slope stability characteristics of these shales, techniques were developed for using nuclear explosives to produce linear craters that have initially flat slopes of the order of 7 to 9°. Experiments indicate that nuclear excavation using a two-pass, triple-row array detonation system may offer a solution to this problem. A preliminary analysis of the topography and geology along the Route 25 sea-level canal alinement through northwest Colombia indicates that conventional excavation techniques, primarily hydraulic dredging, would be the most reasonable method of excavating ~78 miles of the 100-mile alinement. The remaining 23 miles of the alinement, through the Continental Divide, would be excavated using nuclear explosives. Studies in progress pertain to the safety aspects of using nuclear methods to construct a trans-isthmian sea-level canal, including consideration of seismic propagation, airblast acoustical wave phenomena, and radioactivity release. The results of such studies to date indicate that the potentially damaging effect on buildings from ground motions resulting from seismic propagations from the nuclear detonations will be the major factor in determining the maximum aggregate yield that can be detonated at any one time along the selected alinement. (auth)

49987 RESULTS OF THE CABRIOLET EXCAVATION EXPERIMENT. Tewes, Howard A. (Univ. of California, Livermore). Nucl. Appl. Technol., 7: 232-42(Sept. 1969).

Project Cabriolet, a nuclear detonation in hard, dry (volcanic) rock, was executed as a part of the Plowshare Program for development of nuclear excavation techniques. Experimental data obtained on crater development and size were used to verify recently developed rock mechanics computer codes and calcula-

tional techniques and the distribution of the radioactivity produced by the detonation was related to shot environment. As was observed in the Danny Boy experiment, a relatively small amount of radioactivity was released to the environment from this detonation in hard, dry rock. Less than the equivalent of fission products from 10 tons of fission were distributed in both fallout and cloud from the Cabriolet experiment. As more data are reduced, a better description of the chemical fractionation associated with this released radioactivity will be possible. (auth)

49988 PROJECT BUGGY: A NUCLEAR ROW EXCAVATION EXPERIMENT. Toman, John (Univ. of California, Livermore). Nucl. Appl. Technol., 7: 243-52(Sept. 1969).

The Buggy experiment demonstrated that under widely varying geologic conditions, a relatively uniform channel was produced which at larger yields would be well suited for canals, harbors, or highway cuts. The dimensions obtained in the Buggy row crater are believed to be primarily due to the cratering characteristics of the Chukar Mesa Basalt Formation, and should not be considered typical for row crater applications. Saturated rock which is likely to be encountered at most locations away from the Nevada Test Site is expected to increase the cratering efficiency of nuclear explosives and lead to larger row dimensions. An advance in nuclear excavation technology has been the development of cratering code calculations which can predict the behavior of rock formations on the basis of in-situ geophysical measurements and high-pressure test data on rock specimens. This capability was critical to the success of the Buggy experiment as there were no calibration single-charge craters (either nuclear or high explosives) on which to base the row crater design. The low values obtained for the mound velocities indicate that formation of a row crater would have been marginal at a deeper depth of burst. (auth)

Facilities and Equipment

Refer also to abstracts 50204, 50211, 50222, 51088, 51421, 51431, 51534, 51576, 52071, 52081, and 52427.

49989 (BNWL 1051(Pt.2), pp 220-2) INHALATION APPARATUS FOR HUMAN METABOLISM STUDIES. McConnon, D. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

A prototype of an aerosol generator and inhalation apparatus with which test material can be quantitatively controlled for studies of the uptake, distribution, retention, and excretion of radioactive materials in humans is described. (W.H.K.)

49990 (CEA-R-3840) CASTOR AND POLLUX: SHIELDED CELLS FOR STUDYING FUEL TREATMENT PROCESSES. Faudot, Gerard; Bathellier, Andre (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). June 1969. 52p. (In French). Dep. CFSTI (U. S. Sales Only).

"CASTOR" and "POLLUX", two alpha, beta, gamma cells, which were designed for improvement studies of the various aqueous separation processes used in irradiated fuels reprocessing plants are described. Located in the same air-tight steel encasement, the cells are inter-connected by a pneumatic transfer tube. These two cells have a similar in-line conception and include gamma shielding in lead of 10 cm thickness and an inner air-tight box, made of stainless steel and plexiglass, which is maintained at a pressure lower than room pressure. Eleven master-slave manipulators allow inner manipulations. (auth)

49991 (EUR-4282) STATISTICAL PARAMETRIC AND NON-PARAMETRIC METHODS TO DETERMINE THE DISTRIBUTION OF MECHANICAL COMPONENTS. Basile, D.; Volta, G. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). July 1969. 62p. (In Italian). Dep. CFSTI (U. S. Sales Only).

Various statistical methods were studied permitting determination of the distribution of the failure probability of a mechanical component using the experimental data obtained by tests on the component itself. Parametrical methods were considered (applying the maximum likelihood principle) and non-parametrical methods (order statistics); particular emphasis was also given to the use of probability papers. The methods for the Weibull distribution were applied to some samples concerning rupture resistance of intermetallic joints and the lifetime of mechanical components. Also presented are three digital computer programs (IBM 360/65) to determine the Weibull parameters, the ranks with a fixed confidence level, and application of the Kolmogorov test. (auth)

49992 (RISO-198) LABORATORY CONTINUOUS FURNACE FOR SINTERING OF UO_2 PELLETS. Soerensen, O. Toft (Danish Atomic Energy Commission, Risoe. Research Establishment). Apr. 1969. 16p. Dep. CFSTI (U. S. Sales Only).

A laboratory high-temperature continuous furnace for sintering UO_2 pellets was designed and constructed at the Danish Atomic Energy Commission Research Establishment, RISO. The furnace system, which consists of automatic loading and unloading units, a tube furnace, and a temperature regulation unit, is described together with the steps involved in a typical sintering in the furnace. To illustrate the suitability of the system developed, typical densities, density and diameter tolerances, and impurity contents of UO_2 pellets sintered at 1700°C are given, and finally the experience gained during long-time performance of the system is described. (auth) (Denmark)

49993 (SAN-681-1) LARGE SODIUM PUMP DESIGN STUDY. Phase 1 Report. (Borg-Warner Corp., Vernon, Calif. Byron Jackson Pump Div.). July 1969. Contract AT(04-3)-681. 442p. Dep. CFSTI.

Large sodium-cooled fast breeder reactor plants in the 1000 to 1500 MW(e) range require sodium pumps with 4 to 9 times the capacity of existing high-temperature pumps. The primary coolant pump must provide absolute containment and isolation of sodium, have performance reliability, design predictability, and operational safety. A detailed design study is presented which gives pump design parameters for applications bracketing a flow range of 10,000 to 200,000 gpm and dynamic heads of 100 to 450 ft and which shows the interrelation of changing the pump design and/or system conditions. Specifically, included in this parametric study were pump design criteria, preliminary specifications, and the preliminary layout based on a recommended concept for the 60,000 gpm, 350 ft head pump. The range of bearing and seal requirements for bearing and seal test facilities were also established, and auxiliary requirements such as bearing sodium flow and pressure, inert gas, and seal fluids are indicated. (L.C.L.)

49994 (TID-25228) STUDY OF 250-MGD MULTISTAGE FLASH DISTILLATION PLANT WITH TWO-LEVEL BRINE FLOW. PART ONE. DESIGN AND COST ESTIMATE. PART TWO. PRELIMINARY ENGINEERING ANALYSIS AND CAPITAL COST ESTIMATE. (Oak Ridge National Lab., Tenn. Bechtel Corp., San Francisco, Calif.). Mar. 1969. 254p. Dep. CFSTI.

Design criteria and cost estimates were developed for a 250-Mgd multistage flash desalination plant which is coupled to one 2500-MW(t) boiling-water reactor. The hypothetical location of the plant is in southern California. The water plant has an average performance ratio over its assumed thirty-year life of 12.8 lb of product/1000 Btu and has a blowdown brine concentration ratio of 2.0. The plant consists of four trains. Each train is 692 ft long and is 90 ft wide on the high-temperature end of the plant and 105 ft wide at the low-temperature end. The flash chamber design incorporates two flashing brine levels and a product water tray. The flashing brine flows through the evaporator stages in two levels. The condenser tube bundles are located at the top of the evaporator structure, and the product water condensate drains into the product tray immediately below the bundles. The product is flashed to downstream stages in the same fashion as the brine. Each plant train is stepped between the heat recovery and the heat reject sections so that condenser tubes approximately 240 ft long can be inserted from either end of the heat recovery section. A single water box is used at the midplane of the heat recovery vessel. The deaerator is a compact two-stage spray chamber. A relatively small quantity of stripping steam is used for stripping air from the feed water. The deaerator is situated adjacent to the heat reject section, which provides the stripping steam. Sulfite is injected to react with any oxygen remaining in the deaerator effluent. Separate brine heaters are provided for each train (two per train). The heater tubing is copper-nickel alloy. This tubing is 24.2 ft long, and the brine velocity in the tubes is 4.5 fps. The seawater intake system is the submarine line type. It was concluded that a 250-Mgd distillation plant can be built for $149,725,000 or 59.9¢/daily gal of capacity, and than annual operating costs with a 5.6% charge rate will amount to 20.6¢/1000 gallons. (J.C.W.)

49995 (UCRL-18423(Rev.)) FATIGUE LIFE GAGES ON A 46,000 kVA GENERATOR UNDER PULSED LOADING. Krevitt, Roland S. (California Univ., Berkeley. Lawrence Radiation Lab.). Aug. 1969. Contract W-7405-eng-48. 43p. (CONF-690917-1). Dep. CFSTI.

From Western Regional Strain Gage Committee Meeting, San Francisco, Calif.

On December 19, 1966, near catastrophic fatigue failures in two 46,000-kVA generators were discovered; a 6-month shutdown of a major nuclear physics research facility resulted. The cost of replacing the failed parts was $330,000. The Bevatron, at the Lawrence Radiation Laboratory in Berkeley, California, is a proton accelerator. A large electromagnet guides the protons in a circular path, and because of the nature of the acceleration cycle, the magnet must be pulsed 11 times per minute with a peak coil

current of 8,400 A and a peak voltage of 16,000 V. This results in a pulsed demand on the generators that supply power to the electromagnet, and causes severe stress in the generator armatures. These cyclic stresses led to fatigue failures. The use of S/N fatigue life gages to detect possible future armature fatigue damage is described. (auth)

49996 (UCRL-18667, pp 322-9) CHEMICAL ENGINEERING. (California Univ., Berkeley. Lawrence Radiation Lab.).

EXTRACTION APPARATUS—development of jet-mixed column-type

LIQUIDS—mixing in closed rectangular tanks, effects of agitator and tank geometry and power requirements on

—surface tension between immiscible, oscillating-jet method for measurement of interfacial

MEMBRANE FILTERS—design for removal of cell-free Streptococcus faecalus from bacteria cultures in fermentation tank

SCHIZOMYCOTA—Streptococcus faecalus, growth in dense cultures, design fermentation system to study

SEPARATION PROCESSES—contacting devices for, evaluation of gas-liquid

SURFACE TENSION—measurement of interfacial, between two immiscible liquids, oscillating-jet method for

TANKS—liquid mixing in rectangular, effects of agitator and tank geometry and power requirements on liquid (J.C.W.)

49997 (Y-1692) COMPUTER-ASSISTED, ADAPTIVELY CONTROLLED MACHINE TOOL SYSTEMS. Williams, T. L. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). Oct. 3, 1969. Contract W-7405-eng-26. 26p. Dep. CFSTI.

In anticipation of the development of a computer-augmented, adaptively controlled, multiaxis machine tool, a literature search was made to determine the availability of hardware that might be used in such a system and to accumulate pertinent information derived from research directed toward such a system. The results indicate that many advantages can be derived from the development of a computer-augmented adaptively controlled (AC) machine tool system. AC will enable a high quality product to be obtained from the fabrication process. (J.C.W.)

49998 RATIONAL CLOSURE SYSTEM FOR RADIATION APPLICATORS. Seela, W. (Medizinische Akademie Carl Gustav Carus, Dresden). Deut. Zahnaertztl. Z., 22: 911-14(July 1967). (In German).

A new type of applicator is described for treatment of the facial skull with ^{60}Co or ^{137}Cs. The advantage of these radioisotopes is the steep fall off in dose when used in contact irradiation treatment. The advantages of the applicator are its simple construction, secure fixation at the location desired, rapid and uncomplicated loading procedure for radiation protection, and a simple, secure closure. These features are discussed in detail. The structure and operation of the applicator is described. (BBB)

49999 IMPROVEMENTS IN AND RELATING TO IRRADIATION APPARATUS. Chenault, Roger; Germond, Philippe; Papot, Lucien; Prigent, Raymond (to Commissariat a l'Energie Atomique). British Patent 1,164,595. Sept. 17, 1969. Priority date Mar. 23, 1967, France.

The design of an irradiation apparatus is given in which radioactive sources in a storage position can be transferred or stored with maximum safety, can be transferred from this safe position to an irradiation position, and can be returned to the initial position. Electrical and electromechanical provisions are provided to inform the users of the position of the source or sources at any time and to permit remote control of the apparatus. The design is adaptable to calibration of radiation monitors, since it can use a number of sources of different activity stored and selected as required to provide different radiation fluxes in the irradiation position. (J.C.W.)

50000 BATTERY COMPRISING A CARBON ANODE CONTAINING A RADIOACTIVE CATALYST. Gumucio, Gardo Salcedo (to Yardney International Corp.). U. S. Patent 3,468,714. Filed May 12, 1961.

A design is given of a battery with a carbon anode containing a radioactive catalyst and a carbon cathode both in contact with an aqueous alkaline electrolyte. A load circuit is connected across the anode and cathode. (TSS) (Offic. Gaz.)

50001 IMPROVEMENTS IN OR RELATING TO CENTRIFUGES. Vallis, Derek Gordon (to United Kingdom Atomic Energy Authority). British Patent 1,161,925. Aug. 20, 1969. Filed Mar. 31, 1967.

Improvements to the centrifuge described in British Patent 982,676 are described. A problem arising in the use of that centrifuge in solvent extraction work arises with regard to collecting the ejected phase, which is sprayed off radially from the porous wall of the rotor; this difficulty arises particularly when a sequence of chemical processing steps is performed under automatic control, involving the ejection of several successive liquid components. Another problem can arise where the centrifuge is used in a process which includes a precipitation step and the porous wall is used as a filter; the centrifuging action has a tendency to trap the precipitate in the angle between the porous wall and the impermeable wall of the cup. In the modified centrifuge described a number of superimposed annular collection galleries is provided, these being coaxial with the cup-shaped rotor. Each gallery has an outlet port and means are provided for moving the galleries axially relative to the rotor, so that each gallery in turn can be positioned to receive liquid sprayed from the porous wall of the rotor. A rotatable stirring rod may be provided which is coaxial with the rotor and has an open ended hollow bore, a helical member extending along this bore, and with an aperture in the wall of the bore through which liquid drawn upwards from the rotor can be ejected towards the upper portion of the rotor walls. (UK)

50002 FLUIDISED BED REACTORS. Toor, F. D. (Atomic Energy Centre, Lahore). Nucleus (Lahore), 6: 10-16(Jan.-Mar. 1969).

Aggregatively fluidized bed reactors are being increasingly employed in the atomic energy field for purposes of reactor fuel processing and reprocessing etc. The mathematical models presented in the literature to account for the lower conversion efficiency of fluidized bed reactors as compared to fixed bed reactors under similar conditions of operation are critically reviewed. (auth)

50003 COOLING LIMITS FOR SOLENOID STABILIZATION IN THE VICINITY OF THE ^4He λ POINT. Frederking, T. H. K.; Purdy, Vance (Univ. of California, Los Angeles). Appl. Phys. Lett., 15: 119-20(Aug. 15, 1969).

The superfluid He II transition to the normal state and the critical dissipation rates for near-isothermal solenoid operation have been measured near the λ point. In contrast to the superfluid quenching limit, the solenoid cooling stability limit was found to be finite at the λ point. (auth)

50004 PLUTONIUM AEROSOL INHALATION APPARATUS. Watanabe, Seiki; Suzuki, Masashi (National Inst. of Radiology Science, [Tokyo]). Nippon Genshiryoku Gakkaishi, 11: 562-6 (1969). (In Japanese).

Studies were made on an inhalation apparatus, and a method for generating submicron aerosol quantitatively in order to establish a method for performing inhalation experiments on hazardous Pu aerosols. The apparatus was designed and constructed, with due consideration given to safety and ease in operation. The apparatus consists of a double system of glove box and exposure chamber, the negative pressure of each system being controlled automatically by means of an electric valve and a needle valve. The leakage from each of the two systems was used for aerosol generation. The characteristics of the system had previously been tested with some inorganic salts. It was ascertained by experiments with the apparatus that even with different materials, when the jet flow rate is held constant, the concentration of dispersed aerosol depends exactly on that of the solution, with a linear relationship. Mock-up tests using radioactive aerosols of short half-lives were carried out, with satisfactory results. (auth)

50005 FREEZING SYSTEM FOR PIPES. Bussi, Jean; Martin, Jean-Paul; Rech, Georges (to Commissariat a l'Energie Atomique). British Patent 1,157,159. July 2, 1969. Priority date Dec. 15, 1966, France.

A system for freezing a liquid in a large diameter horizontal duct, which is particularly applicable to coolant and/or moderator ducts in nuclear reactors is described. The system consists of an annular jacket coaxially placed around the duct and a means of circulating a refrigerant, namely liquid nitrogen which vaporizes within the jacket, through this annular jacket. The jacket has an upper and lower compartment with the upper section having a greater length along the duct than the lower section and two side compartments. Circulation of the refrigerant in the jacket freezes the liquid carried in the surrounded duct. The refrigerant jacket may also be placed in an annular space defined by two coaxial ducts which carry two different liquids both of which can be frozen in the circulation of the refrigerant in the jacket. (L.C.L.)

50006 FLAME-PLATING PROCESS PROVIDES WEAR RESISTANCE. Iron Age Metalwork. Int., 8: No. 4, 34-5(Apr. 1969).

A detonation-gun (D-gun) process applies tungsten, titanium and chromium carbide, ceramic, and aluminum oxide coatings to parts

subject to wear, corrosion, erosion, or heat damage. The metallurgical properties of the base metal are not changed during the plating process, since the temperature in the part being plated remains low, although high temperatures (above 6000°F) are reached within the gun. No distortion of precision parts occurs. (Metals Abstr.)

50007 ALARM SYSTEM FOR UF_6 IN AIR. Culpepper, H. D.; Gentry, W. O. (to United States Atomic Energy Commission). U. S. Patent 3,474,022. Oct. 21, 1969.

A system for giving warning of the release of gaseous UF_6 into air has been developed. The system includes a specially designed heat and vibration-resistant sensor whose electrical resistance decreases markedly if the sensor is exposed to UF_6-containing air. Alarm instrumentation remote from the sensor is actuated by a decrease in the sensor resistance. (AEC)

50008 IRRADIATION SYSTEMS. (to Sulzer Brothers Ltd.). British Patent 1,167,153. Oct. 15, 1969. Priority date Oct. 5, 1965. Switzerland.

A design is presented of an irradiation system with containers for material to be irradiated, a shielded chamber, and means for a supporting cylindrical radiation source within the chamber. A conveyer is situated in the shielded chamber and arranged to entrain the containers and convey them along a circular path around the radiation source. A cylindrical axis of the source coincides with the axis of the circular path, and a rotary lock feeds and delivers containers into and from the conveyer. The rotary lock consists of radiation-absorbing material and has at least one recess for receiving a container. The rotary lock accepts containers from a magazine and feeds them to the conveyer and returns them to a further magazine during one revolution of the rotary lock. (J.C.W.)

50009 IRRADIATION SYSTEMS. (to Sulzer Brothers Ltd.). British Patent 1,167,152. Oct. 15, 1969. Priority date Oct. 5, 1965, Switzerland.

A design is presented of an irradiation system with containers for material to be irradiated in a shielded chamber supported by a cylindrical radiation source within the chamber. The conveyer is arranged to entrain containers along a circular path around a radiation source. A cylindrical axis of the radiation source coincides with the axis of the circular path, and a stationary track extends around the path and is arranged to impart a rotation to each container about an axis approximately parallel to that of the circular path. The stationary track consists of a curved rack and each container has a gear wheel which engages the rack as the container is conveyed around the radiation source. The rotary lock contains radiation-absorbing material and has at least one recess for receiving a container. The axis of the circular path is horizontal and the rotary lock is coupled with a control device for the feeding of containers one at a time into the recess in the rotary lock. (J.C.W.)

50010 ELECTRICAL CONNECTOR FOR USE IN LIQUID METAL. Hutter, Ernest; Hooker, Harris H. (to United States Atomic Energy Commission). U. S. Patent 3,471,826. Oct. 7, 1969.

An electrical socket for multiple connections which may be subjected to immersion in sodium coolant is described. Provision is made for leak-proofing the socket together with a backup safety trap for a minor amount of sodium which is kept from electrical connections by a slight internal positive pressure of argon. (AEC)

50011 INDUSTRIAL IRRADIATION APPARATUS. Atomwirt., Atomtech., 14: 317-18(June 1969). (In German).

Two industrial irradiation devices are briefly described. The first consists of an oven and a sample carrier, which can be obtained in three forms: a simple carrier introduced directly into the oven atmosphere, a thick capsule under protective gas, and a thick capsule for pressures up to 160 bar, containing NaK or Na as heat transfer agent. The second device was developed for the irradiation of fuel materials with high linear output. These devices permit the measurement of the temperature at the interior of the fuel material and the measurement of the radiation output. (J.S.R.)

50012 STRUCTURAL SHIELDING FOR DENTAL X-RAY INSTALLATIONS. Schmidt, Arthur. J. Can. Dent. Ass., 33: 430-2 (Aug. 1967).

Legal aspects and technical data used to evaluate requirements for structural shielding of dental x-ray installations were discussed. It was estimated that 1 in. of concrete or its equivalent would allow 36 exposures/week before a dose of 500 mR in a yr would be exceeded. Average workloads from 2 to 11 times higher than the values resulting from these calculations indicated that a 1-in. concrete wall or its standard equivalent would not sufficiently protect the close vicinity of an average dental office and would not be safe. Dose rates delivered by scattered radiation in normal dental practice seldom require additional attenuation if the distances between scatterer and persons exceed 6 ft. (BBB)

50013 IMPROVEMENTS IN AND RELATING TO APPARATUS COMPRISING A SOURCE OF COLD OR HEAT AND DUCT THROUGH WHICH A MEDIUM CAN FLOW TO TRANSFER COLD OR HEAT RESPECTIVELY FROM THE SOURCE TO A PART LOCATED REMOTELY THEREFROM. (to Philips' Gloeilampenfabrieken). British Patent 1,165,756. Oct. 1, 1969. Priority date Oct. 9, 1965, Netherlands.

An apparatus is described that comprises two sets of heat exchangers and a connecting duct containing heat carrying fluid to transfer heat in either direction. The apparatus may be used to add or remove heat from a part remote from the external heat exchanger. The heat exchangers of the two sets are connected in series in such a manner that those of one set alternate with those of the other. In this way a small flow of medium in the duct is capable of conveying the desired amount of heat. (J.R.D.)

Heat Transfer and Fluid Flow

Refer also to abstracts 50013, 50103, 52305, 52337, 52345, 52354, and 52468.

50014 (AERE-Bib-150(Rev.)) BIBLIOGRAPHY OF REPORTS ON TWO-PHASE HEAT TRANSFER ISSUED BY A.E.R.E., HARWELL. Cousins, L. B. (Atomic Energy Research Establishment, Harwell (England)). June 1969. 24p. Dep. CFSTI (U. S. Sales Only). UK 4s. 0d.

The reports and publications issued by the Two-Phase Heat Transfer Section of the Chemical Engineering Division at A.E.R.E., Harwell are listed and summarized. The reports are divided into: burnout and heat transfer studies; and hydrodynamic studies on air-water systems. A list of other relevant reports issued by A.E.R.E., Harwell is given in the supplement. (auth) (UK)

50015 (AERE-M-2216) BURNOUT HEAT FLUX MEASUREMENTS IN A LONG TUBE. Dell, F. R.; Hewitt, G. F.; Keeys, R. K. F.; Stinchcombe, R. A. (Atomic Energy Research Establishment, Harwell (England)). June 1969. 11p. Dep. CFSTI (U. S. Sales Only). UK 2s. 6d.

Burnout heat flux measurements are reported for upwards water flow in a 0.243 in. bore tube. Tube lengths of up to 217 inches were employed. Data were obtained for mass velocities of 1, 2, and 3×10^6 lb/hr ft^2 with an outlet pressure of 1000 psia. At high exit qualities the results show the expected change in form, indicating an entry into a different regime. (auth) (UK)

50016 (AERE-R-6027) SOME ASPECTS OF HEAT TRANSFER IN A GAS FLUIDISED BED. Henwood, G. A. (Atomic Energy Research Establishment, Harwell (England)). July 1969. 25p. Dep. CFSTI (U. S. Sales Only). UK 4s. 0d.

The wall bed local heat transfer coefficients within a fluidized gas/solid system were determined in a two-dimensional bed using specially designed heat transfer probes. In a series of interrelated experiments the effects on the heat transfer coefficient of the superficial gas velocity, the properties of the solid material and of the fluidizing gas, together with the particle size, were determined. The results are presented as a series of graphs and they are interpreted in terms of a previously published theory. A further series of experiments explored the variation of the local heat transfer coefficient in the vicinity of a large single bubble. It was found that these results provide a qualitatively satisfactory explanation of the overall effect on the heat transfer coefficient when the superficial velocity of the fluidizing gas is varied. (auth) (UK)

50017 (AERE-R-6118) DETERMINATION OF RATE OF DEPOSITION OF DROPLETS IN A HEATED TUBE WITH STEAM-WATER FLOW AT 1000 p.s.i.a. Hewitt, G. F.; Kearsey, H. A.; Keeys, R. K. F. (Atomic Energy Research Establishment, Harwell (England)). June 1969. 13p. Dep. CFSTI (U. S. Sales Only). UK 2s. 6d.

At the burnout or dryout point in heat transfer to two-phase annular flow a mass balance in an element terminating at the burnout point showed that the supply of liquid into this element consisted of two parts: supply along the surface in the form of a film and supply normal to the surface in the form of droplet mass transfer. The magnitude of the latter component was determined for steam-water flow at 1000 psia in a 0.497 in. bore tube by dryout heat flux measurements. By arranging for simultaneous dryout at the end of a heated length of the tube with high heat flux and a further short length of tube with a lower heat flux, it was possible to deduce the magnitude of the droplet deposition. Results were obtained for droplet deposition rate as a function of quality and mass velocity. The contribution of deposition represented a substantial fraction of the burnout flux over the whole range studied. Comparison with earlier data, in which the deposition rate had been determined approximately from upstream

burnout data for non-uniformly heated tubes, showed that the present results indicate slightly higher deposition rates. This suggests that deposition rate cannot be regarded as being a unique function of local quality. (auth) (UK)

50018 (AERE-Trans-1115) COOLANT MIXTURES INVOLVING HIGHLY DISPERSED LIQUID IN SUPERHEATED VAPOUR. Cumo, M. (Comitato Nazionale per l'Energia Nucleare, Rome ([Italy])). Translated by A. Crozy (Atomic Energy Research Establishment, Harwell, Eng.), from report RTI/TR-STAV-(66)3. 23p. Dep. CFSTI (U. S. Sales Only). UK 4s. 0d.

Conclusions drawn from the literature on highly dispersed liquid in currents of vapors or gases are examined. A theoretical procedure is formulated for deducing the characteristic dimensionless groups of the system and the conditions of similitude for the thermodynamic phenomena associated with heat exchange. (18 references). (auth) (UK)

50019 (FEI-150) EFFECT OF THE NONUNIFORM DISTRIBUTION OF HEAT FLOW ALONG A TUBE ON THE HEAT TRANSFER CRISIS. Zenkevich, B. A.; Kalinin, Yu. A.; Remizov, O. V.; Subbotin, V. I. ([Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk]. Fiziko-Energeticheskii Institut). 1969. 64p. (In Russian). Dep. CFSTI (U. S. Sales Only).

The effects of a nonuniform distribution of heat flow along a tube (step $q_{max}/q_{min} = 2.57$) on the heat transfer crisis were investigated for pressures of 686.7 to 1765 n/cm^2, mass velocities of (3.6 to 10)10^6 kg/m^2·hr for tube lengths up to 1.2 m. It was found that for a certain combination of parameters the values of the total power and q_{cr} may strongly depend on the law of heat release. Tables of the experimental data are given. (auth)

50020 (GEAP-10055) TWO-PHASE FLOW AND HEAT TRANSFER IN MULTIROD GEOMETRIES. Fourteenth Quarterly Progress Report, January 1-March 31, 1969. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Apr. 1969. Contract AT(04-3)-189. 18p. Dep. CFSTI.

Work connected with subchannel flow tests in the nine-rod test section is described. The work included calibration of calorimeter (i.e., determination of heat loss), determination of ΔP setting for isokinetic sampling in the corner subchannel, single- and two-phase sampling of corner subchannel flow, and single- and two-phase pressure drop. Results were tabulated and plotted. The results showed that, in the range of conditions tested, both the mass velocity and the quality in the corner subchannel were less than the average for the channel. The mass velocity in the corner subchannel appeared to approach the average channel value at qualities corresponding to transition from slug to annular flow. (auth)

50021 (JPRS-48330, pp 518-52) PURIFICATION PROBLEMS OF A SODIUM HEAT CARRIER. Subbotin, V. I.; Kozlov, F. A.; Gorchakov, M. K.; Volchkov, L. G.; Ivanovskii, N. N. Translated from pp 534-60 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 1, Obninsk, 1967.

Methods of liquid sodium coolant purification are reviewed. Discussions are included on the characteristics of cold traps, processes occurring in cold traps, testing cold traps, and the use of filters in conjunction with cold traps. (J.R.D.)

50022 (JPRS-48330, pp 591-610) WORK ON THE TECHNOLOGY AND HEAT TRANSFER OF LIQUID METALS. Andreev, P. A.; Borishanskii, V. M.; Kalachev, D. M.; Firsov, E. V.; Ulitskii, P. I.; Shneiderman, L. L. Translated from pp 594-612 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 1, Obninsk, 1967.

Results of research on heat transfer and hydraulic resistance of liquid metals are reviewed. Information is included on control of impurities in liquid metals and control of liquid metal composition Experience in the use of liquid metal cooling systems is summarized. (J.R.D.)

50023 (JPRS-48330, pp 611-26) SODIUM HEAT-TRANSFER AND TECHNOLOGY EXPERIMENTS ON PLANTS OF THE NUCLEAR RESEARCH INSTITUTE OF THE CZECHOSLOVAK ACADEMY OF SCIENCES. Pasek, M.; Sulc, V. Translated from pp 613-26 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 1, Obninsk, 1967.

Research on heat transfer by liquid sodium is reviewed. Progressive loop design for more extensive heat transfer experiments is described. Loop conditions are discussed in relation to experimental results. (J.R.D.)

50024 (JPRS-48330, pp 627-39) TECHNICAL AND TECHNOLOGICAL PROBLEMS OF EXPERIMENTAL RESEARCH ON THE BOILING OF ALKALI METALS. Ruzhanskii, B. Translated from pp 627-38 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 1, Obninsk, 1967.

Research directed toward the use of liquid metals in fast and thermal reactors and in power cycles is reviewed. Research on boiling alkali metals is summarized. Discussions are included on investigation trends, loop equipment design, and problems associated with high temperature liquid metals. (J.R.D.)

50025 (RPI-3639-11) BUBBLE RISE VELOCITIES IN TWO DIMENSIONAL GAS FLUIDIZED BEDS FROM PRESSURE MEASUREMENTS. Littman, Howard; Homolka, George A. J. (Rensselaer Polytechnic Inst., Troy, N. Y.). Mar. 20, 1969. 34p. (CONF-690307-4). Dep. CFSTI.

From Advances in High-Pressure Technology Symposium, New Orleans, La.

Bubble rise velocities were determined from pressure-time measurements along the vertical axis of symmetry of injected bubbles in a two-dimensional gas fluidized bed. The results were: $U_b = 0.53\ (ga)^{\frac{1}{2}}$ or $U_b = 0.44\ g^{\frac{1}{2}}A_b^{\frac{1}{4}}$. (auth)

50026 (SAN-651-101) ORGANIC WORKING FLUID THERMAL STABILITY INVESTIGATION, A.E.C. RANKINE CYCLE TECHNOLOGY PROGRAM. TOPICAL REPORT. Internal Report No. AER 570. Niggemann, R. E.; Sibert, L. A. (Sundstrand Aviation-Rockford, Ill.). [1969]. Contract AT(04-3)-651. 214p. Dep. CFSTI.

Working fluids to be used in an organic Rankine cycle power conversion system capable of long duration operation in a space environment were evaluated. A detailed investigation of the pyrolytic degradation of biphenyl and the eutectic mixture of biphenyl and phenyl ether (Dowtherm A) was completed. Four hermetically sealed test loops were fabricated, charged with the working fluids, and operated for various lengths of time. Fluid samples were taken periodically and analyzed for physical and chemical properties. The results showed that at 700°F the degradation rates are so small that no appreciable concentration of high boiling compounds will occur in a system after many tens of thousands of hours and that the percentage degradation of the total loop inventory is a function of the ratio of the boiler inventory to total loop inventory. The projected degradation of the loop inventory to 10,000 hours was about 0.15% for the 700°F Dowtherm A and 0.16% for 700°F biphenyl. (L.C.L.)

50027 (SAN-651-107) ORGANIC RANKINE CYCLE TECHNOLOGY PROGRAM. Quarterly Progress Report No. 13, April 1, 1969-June 30, 1969. Niggemann, R. E. (Sundstrand Aviation-Rockford, Ill.). Aug. 29, 1969. Contract AT(04-3)-651. 75p. Dep. CFSTI.

The investigation of the technology necessary to successfully develop an Organic Rankine Cycle power conversion system capable of long duration operation in a space environment was continued. The specific working fluids being evaluated are biphenyl and the eutectic mixture of biphenyl and biphenyl ether. The four main areas of investigation include: the pyrolytic degradation of the working fluids; the performance and stability of bearings operating in the eutectic mixture; evaluation of small high speed condensate pumps operating at high suction specific speeds with the eutectic mixture; and the heat transfer, preformance characteristics, and stability of organic working fluid boilers. The working fluid investigation indicated that both biphenyl and the eutectic mixture are about equally stable, exhibiting only 0.15% degradation of the loop inventory in 10,000 hrs at 700°F. Hydrodynamic bearings of several types operated satisfactorily with the eutectic while the only roller bearing tested seriously degraded after 25 hours. The condensate pump investigation showed that the pumping power for a jet condenser is comparable to that required by a surface condenser system. The boiler performance was satisfactory with the observed heat transfer coefficients in the range of the predicted values. In addition, the scope of this investigation was increased to include a performance evaluation of the Sunstrand 6 kW(e) organic Rankine cycle power system which involves: design of inventory control sub-system to operate with jet condenser system; comparison of condensing techniques; design, fabrication, and testing of modified equipment to allow operation at 700°F saturated vapor; investigation of working fluid degradation at 700°F; and vibration testing of fluid film bearings. The jet condenser operated satisfactorily. The designs of the 700°F nozzle ring and boiler were completed. (L.C.L.)

50028 (WANL-TME-1873) AUTOTEM: A COMPUTER PROGRAM FOR AUTOMATED GEOMETRY MESHING AND HEAT CONDUCTION CALCULATION. Lee, A. Y.; Wells, K. J. (Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.). Nov. 1968. Subcontract NP-1. 101p. Dep. CFSTI.

A description and directions for use of the computer code

AUTOTEM (AUTOmatic TEMperature calculations) are presented. The AUTOTEM code was developed for automating the procedure of modeling and obtaining temperature distributions for a given two-dimensional irregular body with a geometry description such as engineering drawing information as input. The code meshes the solid into a nodal system as required by the heat transfer calculation codes. The nodal system, as generated, is plotted on the SC 4020 data plotter for visual inspection. Temperature distributions are determined using finite difference numerical solutions. From these calculated nodal temperatures isotherms can be plotted for specified temperature values. The AUTOTEM code can handle any two-dimensional (constant in the third dimension) or axial symmetrical body consisting of a single material. Time dependent internal heat generation, temperature dependent material thermal properties, and time dependent boundary conditions can be considered. (auth)

50029 ABOUT SUPER-HEATING OF LIQUID SODIUM. Prisnyakov, V. F. At. Energ. (USSR), 27: 225-6(Sept. 1969). (In Russian).

The process of superheating of liquid sodium in fast reactor channels before an emergency situation arises was studied. A relation between the boiling point superheating, and saturation temperature was analyzed. Averaged magnitudes of liquid sodium superheating were used for construction of a graph considering the superheating temperature equal to 2124°K and pressure of 116 atm. The curve obtained is recommended for determining liquid sodium boiling point. (R.V.J.)

50030 AN EXPERIMENTAL STUDY OF THE INFLUENCE OF NUCLEAR RADIATION ON BOILING IN SUPERHEATED LIQUIDS. El-Nagdy, M. M. Manchester, Eng., Univ. of Manchester, 1969. 191p.

Thesis.

Under favorable conditions nuclear particles, in passing through superheated liquids, will cause nucleation. This phenomenon has been exploited in the well-known use of bubble chambers for nuclear radiation detection and measurement. A theoretical investigation of the conditions under which radioinduced nucleation may take place in superheated water, acetone, and benzene is described. A bubble chamber-type apparatus capable of achieving superheats of the order of 100°C, was constructed. Experiments were then carried out to study neutron-induced nucleation for 2.45 and 14.1 MeV in the test liquids. Special care was taken to eliminate nucleation at surface irregularities or suspended particles, or nucleation due to dissolved gases, and this appears to have been achieved. It was found that for each liquid and neutron energy a superheat existed below which the liquid was insensitive to the radiation. Using a modified Lomer-type analysis it was deduced that, when undergoing fast neutron irradiation, nucleation in the superheated test liquids is induced by knocked-on oxygen and carbon ions. By adopting an energy deposition density criterion, it was found that theoretical minimum superheats for sensitivity to radiation thus calculated agreed surprisingly well, in the case of water, with those found experimentally. The term $6.48 : 2R_c$ was derived from Rayleigh's perturbation-wavelength criterion for most rapid break-up of a vapor jet surrounded by liquid. For acetone and benzene it was found that the disagreement with experiment, although less than that with previous models, was still substantial. (auth) (UK)

50031 PROPAGATION OF PRESSURE WAVES IN TWO-PHASE MEDIA. Hamilton, Louis James. Berkeley, Calif., Univ. of California, 1968. 301p.

Thesis.

A full understanding of how pressure waves propagate in two-phase media is required for the safe design of nuclear reactors. A combined theoretical and experimental investigation of pressure wave (compression and rarefaction) propagation in channels carrying two-phase mixtures under steady flow conditions has been performed. Both two-component (air–water) and single-component (steam–water) mixtures have been studied for a range of void fractions and various phase distributions to evaluate the dependence of the speed of propagation and wave form on the interphase transfer of mass, momentum, and energy. A two-phase loop was constructed to investigate the phenomena. Downward moving pressure waves were initiated in a 2-in. ID vertical test section by bursting a diaphragm. The wave forms and propagation velocities were determined by means of miniature pressure transducers flush mounted in the wall of the test section. The propagation of compression and rarefaction waves in homogeneous-bubbly, air–water mixtures was investigated first. The compression waves were found to steepen into fully developed shock waves, while the rarefaction waves broadened as they propagated. The velocities of both the compression and rarefaction waves were found to depend on the bubble size. For those cases where the average bubble diameter was very small (0.008 in.), good agreement resulted between the experimental data and a theoretical analysis assuming thermodynamic equilibrium between the gas and liquid phases. On the other hand, when the average bubble diameter was large (0.150 in.), an analysis which assumed the gas phase to pass through the waves adiabatically proved appropriate. In contrast to shock waves in pure gases, fully developed shock waves in bubbly air–water mixtures were found to be very thick (1 to 20 cm). Next, the propagation of compression waves in ducts carrying air–water, annular-dispersed flow was examined. It was found that the measured wave velocities agreed well with values calculated by assuming the channel contained the gas phase only. Finally, the propagation of both compression and rarefaction waves in homogeneous-bubbly, steam–water mixtures was investigated. The majority of the compression waves and all of the rarefaction waves broadened as they traveled. It was only at very small void fractions ($\alpha < 2\%$) that some of the compression waves steepened. The velocities of the leading edges of the waves were found to be bounded from below by the two-phase sound speed calculated assuming thermodynamic equilibrium between the phases, and from above by the two-phase sound speed calculated assuming no heat or mass transfer between the phases. The measured wave velocities showed better agreement with the equilibrium sound speed when the average bubble size was small. As the bubble size increased, the wave velocities approached the no heat or mass transfer sound speed. The leading edge velocities were found to be independent of whether the waves were compressions or rarefactions. (Disser. Abstr.)

50032 ON MATHEMATICAL DESCRIPTION OF DYNAMIC PROCESSES IN TWO-PHASE COOLANT PASSING THROUGH DUCT. Bondarenko, A. V. At. Energ. (USSR), 27: 226-8 (Sept. 1969). (In Russian).

A mathematical analysis was made of dynamic processes in two-phase coolants passing through a duct which involves flow rate variations, vapor content at the pipe exit, and the pressure drop. The problem was resolved using linear approximations and assuming constant magnitudes different from the slip coefficient. Variations of the vapor pressure on specific weights were neglected as well as the specific heat capacity of the phases. The Laplace transforms were used for resolving combined equations for the metal temperature, linear equations of discontinuity, and conservation of energy for deflections of the vapor volume content and water rate from the initial magnitude constants along the length of the flow. A separate solution is given for the conservation of motion in relation to the pressure variations. (R.V.J.)

50033 THE CALCULATION OF THE VOLUMETRIC VAPOUR CONTENT DURING EVAPORATION IN SUBCOOLED LIQUIDS. Katsaounis, A. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m. b. H., Geesthacht, Ger.). Brennst.-Waerme-Kraft, 21: 410-18(Aug. 1969). (In German).

In the nuclear and thermodynamic design of water-cooled and water-moderated reactor cores it is very important that the volumetric vapor content in the primary system be determined first. Three programs for computating the volumetric vapor content in the subcooled liquid, using three different methods, are described. The values of the vapor content thus determined were compared with known test results with the aid of a correlation program. It was found that the computation of the volumetric vapor content using the Levy method is the best calculation-method if the recondensation of the vapor in the subcooled liquid is considered. (auth)

50034 ROLE OF INERT GAS IN INCIPIENT BOILING LIQUID METAL EXPERIMENTS. Singer, Ralph M.; Holtz, Robert E. (Argonne National Lab., Ill.). Int. J. Heat Mass Transfer, 12: 1345-60(Sept. 1969).

A theoretical study of the effects of inert gas on incipient superheat is presented. It was found that the gas diffusion from surface cavities into the liquid solution accounts for the so-called "heat-flux effect." It was concluded that almost all of the published data do not include sufficient information to adequately characterize the experimental systems. The non-specification of the inert gas partial pressure in the gas cover blanket, for example, can cause an uncertainty in the incipient superheats as large as 100°C. (UK)

Isotope Technology

Refer also to abstracts 49744, 49903, 49958, 49998, 50026, 50085, 50177, 50178, 50203, 50205, 50222, 50668, 51001, 51040, and 51109.

50035 (CEA-R-3834) ISOTOPIC MICROGENERATORS 1 VOLT. Bomal, Robert; Devin, Bernard; Delaquaize, Philippe (Commissariat a l'Energie Atomique, Saclay (France). Centre

d'Etudes Nucleaires). June 1969. 72p. (In French). Dep. CFSTI (U. S. Sales Only).

Various configurations for electrical isotopic generators in the milliwatt range were investigated. The four types of energy conversion methods examined included thermionic, thermophotovoltaic, radiovoltaic, and wired thermoelectric. The desired result was not the best energy conversion efficiency, but achievement of a direct 1 V output. High temperature ^{238}Pu sources (T above 1000°K) were isolated by multilayer thermal insulation material of the Moly/Alumina type. An optimized application is given. The thermionic method was interesting because it is compact. The wired-thermoelectric method is cheap, simple, and rugged. Neither method extended the output voltage much above 1 V. TVP and RV, can be designed for multivolt application. Radiovoltaic is 1% efficient but irradiation defects in the semiconductor induced by high energy radiations can strongly limit the lifetime of the generator. Isotope sources technology is the determining factor for these microgenerators. (auth)

50036 (MLM-1605) STABLE GASEOUS ISOTOPE SEPARATION AND PURIFICATION: JANUARY-MARCH 1969. (Mound Lab., Miamisburg, Ohio). Aug. 27, 1969. Contract AT(33-1)-Gen-53. 45p. Dep. CFSTI.

Developments are reported for studies on: carbon isotope separation; stable gaseous isotope separation, including He, Ne, Ar, Kr, Xe, and O; thermal diffusion; and low-temperature processes. (J.C.W.)

50037 (MLM-1635) MEASUREMENTS OF GASEOUS DIFFUSION COEFFICIENTS BY A MODIFIED TWO-BULB METHOD. DuBro, G. A. (Mound Lab., Miamisburg, Ohio). Apr. 18, 1969. Contract AT-33-1-GEN-53. 165p. Dep. CFSTI.

Diffusion coefficients of the systems $^3He-^4He$, He-Ne, He-Ar, Ne-Xe, and Kr-Kr, have been determined as a function of temperature using a modified two-bulb method. The modified method has been developed to investigate diffusion coefficients over a wide temperature range as well as having the capability for measuring isotopic diffusion coefficients. The theory of the method has been developed to account for removal of small non-negligible samples for concentration analysis. The temperature range for the experimental determination of $^3He-^4He$ and He-Ne diffusion coefficients has been extended more than 45°K. The results agreed well with other accepted literature values for diffusion (±2%) and exhibited exceptional concordance with other transport properties. Comparisons with other transport properties were performed by using theoretical expressions which are virtually independent of intermolecular force assumptions. Theoretical diffusion coefficients have been calculated and have been shown to have reasonable agreement (<5%) within the temperature range of this study. (auth)

50038 (MLM-1659) SNAP-19B(IRHS) RECOVERED HEAT SOURCES. Final Report. Loyer, D. E.; Davenport, C. H. (Mound Lab., Miamisburg, Ohio). Sept. 15, 1969. Contract AT-33-1-GEN-53. 59p. Dep. CFSTI.

Two SNAP-19B (IRHS) heat sources which had fallen into the Pacific Ocean on May 18, 1968, as a result of the abort of a NIMBUS-B satellite were recovered on October 9, 1968. A health physics survey of the sources revealed no release of radioactivity. A set of procedures for extensive examination of the two capsules was prepared. The heat sources were radiographed and photographed in the as-received condition. The radiographs indicated that the fuel was agglomerated, but was still contained within the capsule. Since the start of the examination on January 9, 1969, both heat sources were disassembled; the fuel was removed and fully characterized; fines analyses were conducted on free-flowing fuel from each capsule; heat source components were metallographically examined; and vents were flowchecked and metallographically examined. The examination revealed that while the fuel sintered due to being exposed to high temperature for a prolonged period of time, no other changes in the fuel occurred. (auth)

50039 (MMM-3824-37) SNAP-23A PROGRAM, PHASE 1, THERMOELECTRIC CONVERTER DEVELOPMENT PROGRAM. Quarterly Report No. 10, April 1-June 30, 1969. (Minnesota Mining and Mfg. Co., St. Paul. Electrical Products Group). July 31, 1969. Contract AT(30-1)-3824. 89p. Dep. CFSTI.

The development of a thermoelectric converter to be used in the 60 W SNAP-23A terrestrial radioisotope power supply system is reported. The design details were specified following experimental studies of the machinability of Inconel 625 and Min-K-2002, welding materials and methods, and the performance and leak requirements of the power cable. Life testing was continued to determine the long-term performance of several converters with 6- and 10-couple modules. (L.C.L.)

50040 (ORNL-IIC-19) ISOTOPE USER'S GUIDE. McKinney, F. E.; Reynolds, S. A.; Baker, P. S. (Oak Ridge National Lab., Tenn.). Sept. 1969. Contract W-7405-eng-26. 96p. Dep. CFSTI.

Approximately 200 commercially available radioisotopes are listed, with their radiations and production methods included. Definitions associated with physics used with radioisotopes are provided. Assistance in choosing an isotope for a specific use, shipping information, and special irradiation services are given. The stable isotope list includes nearly all of the existing non-radioactive isotopes, since they have been enriched. An extensive list of available radioisotopes with principal characteristics is included. (J.C.W.)

50041 (ORNL-IIC-22(Pt.2)) SELECTED ABSTRACTS OF WORLD LITERATURE ON PRODUCTION AND INDUSTRIAL USES OF RADIOISOTOPES (FROM NSA APRIL-JUNE 1969). Gerrard, Martha; Baker, P. S. (Oak Ridge National Lab., Tenn.). Sept. 1969. Contract W-7405-eng-26. 38p. Dep. CFSTI.

Approximately 330 abstracts of domestic and foreign publications on the production and use of radioisotopes and radiation, selected from the April to June 1969 issues of Nuclear Science Abstracts, are presented. (auth)

50042 (ORO-667) PROGRAM DESIGN AND SYSTEMS ANALYSIS. (Southern Interstate Nuclear Board, Atlanta, Ga.). Nov. 15, 1968. Contract AT(40-1)-3764. 43p. Dep. CFSTI.

The Isotopes Information Center at Oak Ridge National Laboratory carries out a program of international scope in the collection, evaluation, and dissemination of information on the production and uses of radioisotopes. The program described was assigned to identify the capabilities of the Center, relate these findings to the needs of the industrial community, sponsor a stronger operational rapport between the suppliers and the potential users, and promote an operational liaison and reciprocal services concept between the Center and the industrial segment. The Southern Interstate Nuclear Board was charged with responsibility for furnishing necessary personnel, facilities, equipment, materials and supplies, development of the program, and the design and performance of a systems analysis. (J.C.W.)

50043 (SC-DR-69-490) SNAP-19 RESIDUAL FIRE TEST. Berry, R. E. (Sandia Labs., Albuquerque, N. Mex.). Aug. 1969. 63p. Dep. CFSTI.

Two residual fire tests were performed on SNAP-19 test items to evaluate the response of the test items to a 30 minute JP-4 fire environment which produces a temperature of about 1850°F at 24 inches above the liquid level. The first test included only a SNAP-19 Dispersion System Generator. The second test included four test items, and each test item was positioned to provide specific fire information on that item. The items were: a Dispersion System Generator; a Dispersion System Capsule; an Intact Reentry Heat Source Generator System; and an Intact Reentry Heat Source Capsule. (auth)

50044 ON THEORY OF IDEAL NONSYMMETRICAL SEPARATION CASCADES. Kolokol'tsov, N. A. At. Energ. (USSR), 27: 9-13(July 1969). (In Russian).

Two component nonsymmetrical cascades for isotope separation were investigated. It was found that in a nonsymmetrical cascade such a stageflow distribution can be found in which there shall be no mixing of flows with different concentrations at the entry to the stage. The corresponding optimum cut was found. The condition of no mixing was in this case equivalent to the condition of minimal overall flow investigated by Bouligand. These results were compared with theoretical results, published previously by others. It was also found that the optimal flow distribution in ideal cascades can be easily deduced using a simple formula for the separative power of a stage with different cuts. (auth)

50045 CONDITIONING OF RADIOISOTOPES FOR INDUSTRIAL APPLICATIONS. Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.), Suppl., No. 76, 19-23(Mar.-Apr. 1969). (In French).

The characteristics, packaging, and uses of ^{82}Br-methyl bromide, ^{82}Br-dibromobenzene, short-lived radioisotopes, refractory sources, radioactive glasses, sands and pebbles, ionizing sources, and β radiography sources are presented. A price list for these sources is given. (J.S.R.)

50046 OPTIMAL FEEDBACK CONTROL OF THE RADIOACTIVE VOLTAGE STANDARD. Braudaway, David William. Albuquerque, N. Mex., Univ. of New Mexico, 1968. 157p. Thesis.

Problems in maintaining a reference voltage using standard cells led to the need for alternate techniques of producing a highly predictable voltage. The development of a technique which relates voltage to the activity of a radioactive source, and which, with careful choice of the radioactive source permits realization of the desired goal of one-part-in-ten-million predictability. A

two-limb calorimeter is used to realize the desired function. Heat flow in each limb produces a temperature rise across the limb air gaps. In one limb, the temperature rise caused by the radioactive source is sampled by a pair of temperature-sensitive resistors. In the other limb, a second pair of resistors samples the temperature rise caused by the resistive heater. These four temperature-sensing resistors are connected to form a bridge which is balanced when the heat outputs of the sources are matched. While the bridge output is a measure of system response and power balance, the output voltage is produced by a sampling resistor connected in series with the heater. Because the thermal time constants of the system are long, automatic control of the balanced condition is desired. System operation is evaluated in terms of a quadratic performance index for each of two criteria. The primary criterion is employed when use of the system output is necessary. Under this criterion the two power levels must be held in balance and the rate of change of heater current must be minimized. Where the system output is not used, the secondary criterion is employed in which weighting of the rate of change of heater current is reduced, producing a faster response. By use of the maximum principle a realizable optimal feedback control is developed for each of the two quadratic criteria. Use of optimization techniques assures that the produced voltage is nearly as predictable as is the radioactive source activity. This condition makes practical use of the device as a standard. (TSS) (Disser. Abstr.)

50047 METHOD OF MEASURING OIL CONSUMPTION IN AN ENGINE. Mayer, William J.; Krause, Douglas P.; Lange, Walter H.; Moore, Caleb P. (to General Motors Corp.). U. S. Patent 3,471,696. Filed Mar. 16, 1967.

A method is described for measuring crankcase oil consumption by adding a radioactive halogen compound (1,2-dibromooctadecane) to the oil, operating the engine with lead-free fuel containing ethylene bromide, and collecting the radioactive halide combustion products (HBr) from the exhaust gases wherein the activity of the collected sample is proportional to the oil consumption rate. The tracer is collected by reacting with a basic solution (NaOH) in an extraction tower or in a canister containing porous pellets soaked with the basic solution. (Offic. Gaz.)

50048 RADIO-ISOTOPE (^{32}P) AND WATER QUALITY. Mathur, R. P.; Khanna, P.; Saraswat, I. P. (Univ. of Roorkee, India). J. Inst. Eng. (India), Public Health Eng. Div., 48: 206-12(June 1968).

Since it is desirable to determine the bacterial quality of drinking water at the time it is consumed, and since phosphorus is an essential element for a bacterium as nucleoside phosphorylase, a study was made of ^{32}P assimilation and its possible use in forecasting the bacterial quality of water. Ganges Canal water was mixed with fixed amounts of sterilized water. Carrier free ^{32}P was equilibrated with bacterial suspensions. After washing and filtering, Geiger–Mueller measurements were made to determine the activity of the ^{32}P, and the amounts of activity were correlated to contact time, the effects of bacterial concentration and temperature on ^{32}P assimilation, and the relationship between assimilated ^{32}P and pH-values. It was concluded that the ^{32}P method is rapid, economical, and has advantages over conventional water quality testing methods. This radioactive test can be used at a pH value of 8, 37°C temperature, volume of substrate of the same order of magnitude as that of M.F. test, and with an activity of approximately 0.50 microcurie per sample for a contact time of 4 to 5 hours. (L.C.L.)

50049 THERMOELECTRIC GENERATORS HEATED WITH RADIOISOTOPES. Alais, Michel. Entropie, No. 27, 21-7 (May–June 1969). (In French).

In many rather inaccessible places such as submarine bottoms, and polar zones, the need is felt to have very long life electric energy sources. The adjustment of the thermoelements, a reliable way to convert thermal energy into electric energy, and the long period radioactive sources considered as heat sources, make it possible to have almost permanent electric generators. The principle of operating the thermoelectric generators is indicated. Output values, the choice of radioisotopes, and radio protection are discussed. GISETE 5, a 15 watts generator using a source of 80,000 Ci of ^{90}Sr is described. (auth)

50050 RADIOISOTOPE AND THERMOELECTRIC CONVERSION GENERATORS. Thery, Pierre. Entropie, No. 27, 29-33 (May–June 1969). (In French).

The radioisotopes and thermoelectric generators may be considered as a very reliable solution for long duration for problems of electric energy generation in a submarine medium. Generators Marguerite 2, operating in Mediterranean Sea since February 1968, and Marguerite 20, loaded in May 1969 to be immediately immersed are discussed. (J.C.W.)

50051 INDUSTRIAL APPLICATIONS OF RADIATION. Lambert, Jacques. Entropie, No. 27, 35-41(May–June 1969). (In French).

Examples of various applications are given to emphasize the techniques founded on the utilization of radiations in various fields. The possibilities afforded by the irradiation show that the industrial stage is now reached. A plant in operation for several years is described. (J.C.W.)

50052 ISOTOPIC GENERATORS, CHEMISTRY, AND INTERNATIONAL COOPERATION IN EUROPE. Perret, M. R. P. Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl), No. 76, 19-25 (Mar.-Apr. 1969). (In French).

The development of isotopic generators in the United States is compared with the development in Europe. The lack of military needs for these generators and an industrial base for the production of radioisotopes have retarded the development of these devices in Europe. However, radioisotopes are now becoming readily available in Europe. The future development of isotopic generators in Europe is considered, and the international syndicates studying their use are discussed. The role of chemistry in the development of isotope generators is defined. (J.S.R.)

50053 WORKING CONCEPT OF ISOTOPIC SEPARATION (ACCORDING TO THE AMERICAN REPORT ORO–658). Blum, Jacques M. Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.), No. 76, 26-9(Mar.-Apr. 1969). (In French).

The quantity of natural uranium necessary to give a given enrichment and the separation work necessary are calculated and the results are tabulated. (J.S.R.)

50054 ROCKET ENGINES. Simms, Richard (to TRW Inc.). British Patent 1,164,656. Sept. 17, 1969. Priority date Aug. 1, 1966, United States.

The design of a rocket engine with a conventional system until the liquid propellant reaches the expansion chamber changing it to a gas is described. Enclosed in the chamber is an independent radioisotope capsule which further raises the temperature of the gas. An electric heating unit in the same chamber with the radioisotope capsule also further raises the temperature completely changing the propellant to a gas which is thrust against the walls of another chamber causing useful thrust. (J.C.W.)

50055 WORK OF ENEA ON RADIOISOTOPIC BATTERIES. Ind. At., 13: No. 5-6, 67-8(1969). (In French).

The work of the ENEA on radioisotopic batteries has concentrated on the development of batteries for cardiac pulsers and for horological purposes. The cardiac pulsers have been developed to the point where animal tests are planned with possible use for human implantations in 1970. A radioisotopic battery prototype for use in a clock has been prepared. (J.S.R.)

50056 ON THE ORGANIZATION OF THE PRODUCTION OF ISOTOPES, RADIATION SOURCES, RADIOISOTOPIC DEVICES USED FOR THE CONTROL OF TECHNOLOGICAL PROCESSES, AND IRRADIATION PLANTS IN THE U.S.S.R. AS WELL AS ON THE ORGANIZATION OF ITS INTRODUCTION INTO INDUSTRY. Martinow, S. P. Isotopenpraxis, 5: 174-8(May 1969). (In German).

Problems discussed concerning the production of isotopes, radiation sources, and radioisotopic devices in the USSR include: isotope production and technology; planning and specialization of the industrial manufacture of isotopic products and devices; economic reflections; and use of atomic energy and training for it. (auth)

50057 ISOTOPES AROUND THE WORLD. Isotop. Radiat. Technol., 7: 108-25(Fall 1969).

The design, installation and operation of Sweden's first radioisotope-powered navigational light, installed in 1967 and powered by a $^{90}SrTiO_3$-fueled RIPPLE VI generator, are described. A brief summary of the results of a 1966 survey conducted to determine the uses of radioisotopes in French industries is included. (L.C.L.)

50058 A SUMMARY OF RECENT WORK BY THE FRENCH IN THE DEVELOPMENT OF ISOTOPIC THERMOELECTRIC GENERATORS. Hess, D. N. Isotop. Radiat. Technol., 7: 99-107(Fall 1969).

The current status of French isotopic thermoelectric generators—Geter-2B, Marguerite II, and Marguerite 20—is reviewed. Design considerations, materials specifications, operating parameters, on-site installation, and performance are among the subjects discussed. Power demands for operational and projected generators for specific applications are listed. The fabrication of the $^{90}SrTiO_3$ heat sources for a number of different generators is summarized, with special emphasis on the materials, their requirements and evaluation, and on the preparative procedures involved. (auth)

50059 USE OF RADIOLUMINESCENT MATERIALS IN SPACE. Lahr, T. N. Isotop. Radiat. Technol., 7: 64-7 (Fall 1969).

The uses of microspheres of ^{147}Pm in radioluminescent devices—in the Apollo space program are described. These include a target for docking the lunar module and the command and service module, switch tips, a lunar landing indicator, and other markers. Some information is given on the background of the radioluminescent devices. (auth)

50060 ^{252}Cf: A NEW ISOTOPIC SOURCE FOR NEUTRON RADIOGRAPHY. Reinig, W. C. (E. I. du Pont de Nemours and Co., Aiken, S. C.). Isotop. Radiat. Technol., 7: 62-3 (Fall 1969).

The properties of ^{252}Cf that make it suitable for use as a neutron source in neutron radiography are described. (auth)

50061 X RAYS FROM RADIOACTIVE ISOTOPIC SOURCES FOR DIFFRACTION ANALYSIS. Preuss, Luther E.; Toothacker, William S. (Edsel B. Ford Inst. for Medical Research, Detroit). Isotop. Radiat. Technol., : 54-62(Fall 1969).

The use of x rays from beta-excited and electron-capture x-ray sources is reviewed critically. The difficulty caused by self-absorption of soft photons because of the geometry requirements is discussed. Sufficient intensity will probably not be achieved for practical use with beta-excited sources, but electron-capture sources such as ^{55}Fe have definite promise, especially for portable use in remote locales. (auth)

50062 ISOTOPES AND RADIATION TECHNOLOGY. Volume 7, Number 1. Baker, P. S.; Lafferty, Robert H. Jr.; Gerrard, Martha; Greene, R. E.; McKinney, F. E.; Miller, F. J.; Hess, D. N.; Rupp, A. F. (eds.). One of Four Quarterly Technical Progress Reviews Published for the Division of Technical Information, USAEC. Oak Ridge, Tenn., Oak Ridge National Lab., Fall 1969. 140p. GPO $0.70.

Separate abstracts were prepared for 11 of the 14 papers presented. The remaining three papers were extracted from reports previously included in NSA as 22: 37945, 23: 16010, and 23: 16552. (W.H.K.)

For abstracts of individual papers see: 49878, 50057–50061, 50063–50065, 50201, and 50967.

50063 ORNL ISOTOPES TARGET PROGRAM, 1965–1967. Kobisk, E. H. (Oak Ridge National Lab., Tenn.). Isotop. Radiat. Technol., 7: 1-19(Fall 1969).

The facilities and capabilities of the Oak Ridge National Laboratory Isotope Target Center are described. Reduction–distillation and crystal-bar techniques for preparing high-purity materials are discussed, as are various procedures for preparing self-supported and supported films by vacuum evaporation and for making rolled foils. (auth)

50064 MINIATURE ^{125}I X-RAY SOURCE. Isotop. Radiat. Technol., 7: 20-2(Fall 1969).

A miniature x-ray source that may be used for radiography of industrial equipment, bones, and teeth, is described. The source consists of ^{125}I deposited on a 0.5 mm dia wire sealed in a metal capsule. Source activities of up to 0.5 Ci may be obtained. (R.C.K.)

50065 THERMAL ANALYSIS OF PROMETHIUM OXALATE. McNeilly, C. E.; Roberts, F. P. (Battelle-Northwest, Richland, Wash.). Isotop. Radiat. Technol., 7: 24-7(Fall 1969).

The stable sesquioxide form of ^{147}Pm is a desirable heat source material. However, since the fission-produced Pm must be chemically separated from other fission and decay products and precipitated as a hydrated oxalate, it is necessary to calcine it to the oxide. Both differential thermal analysis (DTA) and thermogravimetric analysis (TGA) were used in studying this calcination. The experimental procedures are described, and the results are presented graphically to show the effects of atmospheric composition, temperature, and time on the DTA and GTA of promethium oxalate. (L.C.L.)

50066 COMMENT ON "RE-ENTRY OF RADIOACTIVE POWER SOURCES". Willis, C. A. (McDonnell Douglas Astronautics Co., Santa Monica, Calif.). J. Spacecraft Rockets, 6: 864(July 1969).

A rule-of-thumb safety criterion for reducing the radiation hazards of isotopic sources re-entering from space states that 10 times the isotopic half-life should elapse before re-entry. These criteria are rejected as neither necessary nor sufficient because the safety requirements are not the same for different systems, and this generalization is considered misleading and unsound. For re-entry burnup considerations, the hazard potential is stated as simply proportional to the radioisotope inventory. Thus if 1-half-lives were just sufficient for a 10-kW source it would be inadequate for a 100-kW source and unnecessary for a 1-kW source. (L.C.L.)

50067 APPROACH TO THE DESIGN OF A MULTI-FUEL CAPSULE RADIOISOTOPE THERMOELECTRIC GENERATOR. Schumann, F. A. (Isotopes, Inc., Middle River, Md.). Contract AT(29-2)-2062. Nucl. Appl. Technol., 7: 367-73(Oct. 1969).

By applying a statistical environment definition at the initiation of multi-fuel capsule radioisotope thermoelectric generator development, the continual high cost expenditure attributed to re-design common to programs advancing the state-of-the-art can be minimized. The design synthesis is accomplished by first establishing environmental conditions (e.g., peak re-entry temperature) based upon statistically combining the characteristic variables required to define the environment. Selected values from this range of probable environmental conditions along with the structural characteristics is then applied to establish the design requirements of the system. The technique to acquire this result is illustrated by an example system design. A description of the many environmental factors and design requirements imposed on these systems are also discussed. (auth)

50068 COMPARISON OF RADIOGRAPHIC RESULTS OBTAINED AT DIFFERENT ENERGY LEVELS EMPLOYING RADIOACTIVE SOURCES, RADIATION GENERATORS, AND PARTICLE ACCELERATORS. Nardoni, G. (ATB, Brescia, Italy); Giuffre, F. Atti Notiz. (Publ. in Met. Ital.), 24: 106-12(Apr. 1969). In Italian).

The problems in radiography with high energy generators were studied on the basis of the comparison of the radiographs obtained with a ^{60}Co source, a 400 keV x-ray device, and an 18 MeV betatron. The problems of high energy radiography are introduced and the elements which characterize it are summarized. The results obtained experimentally on different thicknesses were compared. The sensitivity of the betatron for thicknesses above 80 mm differed greatly from that of the other energy sources. The criteria to be used in the selection of the accelerator for radiographic purposes are outlined. (tr-auth)

50069 PROBLEMI DELLA SEPARAZIONE ISOTOPICA DELL'URANIO. Atti del Simposio Nucleare di Torino, 1–2 Ottobre 1968. (Problems in the Separation of Uranium Isotopes. Nuclear Symposium, Turin, October 1–2, 1968). Roma, Comitato Nazionale Energia Nucleare, 1968. 293p. (In Several Languages). (CONF-681015).

Seventeen papers were presented at the conference. Four papers were previously abstracted in NSA as 23: 4779, 23: 19904, 23: 19905, and 23: 26453. A separate abstract was prepared for each of the remaining thirteen papers. (J.R.D.)

For abstracts of individual papers see: 50070–50081 and 51001.

50070 URANIUM ENRICHMENT PROBLEMS AS SEEN BY THE ENGINEER CONSTRUCTOR. O'Donnel, A. J.; Dyer, G. H. (Bechtel Corp., San Francisco). pp 9-20 of Problemi della Separazione Isotopica dell'Uranio. Roma, Comitato Nazionale Energia Nucleare, 1968.

From Symposium on Problems Bearing on Isotope Separation of Uranium, Turin, Italy. See CONF-681015.

Aspects of isotope separation capacity are discussed. Information is included on matching supply and demand, separation facility investment costs, auxiliaries such as UF_6 production facilities and power supplies for separation plants, and separation facility operating problems. (J.R.D.)

50071 THEORY OF ISOTOPE SEPARATION BY GASEOUS DIFFUSION THROUGH A MEMBRANE. EFFECT OF THE INTERNAL STRUCTURE OF THE MEMBRANE. Breton, J. P. (CEA, Saclay, France). pp 21-38 of Problemi della Separazione Isotopica dell'Uranio. Roma, Comitato Nazionale Energia Nucleare, 1968. (In French).

From Symposium on Problems Bearing on Isotope Separation of Uranium, Turin, Italy. See CONF-681015.

Calculus was used to interpret, at least qualitatively, the effects of the structure of the porous medium on the flow and the efficiency of isotope separation by gaseous diffusion. The distribution $P_c(\lambda)$ of the length of the segments to be supported on the wall was introduced in the calculations. Unfortunately it was found that this distribution $P_c(\lambda)$, or the structure of the porous medium, cannot be favorable simultaneously with the permeability and to the efficiency of the separation. Good agreement, however, between experimental results and theoretical efficiency were obtained. (tr-auth)

50072 VALUE FUNCTION FOR MULTICOMPONENT ISOTOPE SEPARATION. Lehrer-Ilamed, Y. (Israel Atomic Energy Commission, Tel-Aviv). pp 39-54 of Problemi della Separazione Isotopica dell'Uranio. Roma, Comitato Nazionale Energia Nucleare, 1968.

From Symposium on Problems Bearing on Isotope Separation of Uranium, Turin, Italy. See CONF-681015.

A method is described for calculating an infinite set of linearly independent solutions of the equation $\Omega V(\bar{N}) = H$ where $V(\bar{N})$ denotes the value of one mole of material composition and $H = \delta u/L$ = constant where δu is the separative power and L denotes the flow of L moles per second. Ω is the operator. (J.R.D.)

50073 THEORY OF ISOTOPE SEPARATION ON A THERMODYNAMIC BASIS. Basso, G. (CNEN, Rome). pp 55-72 of Problemi della Separazione Isotopica dell'Uranio. Roma, Comitato Nazionale Energia Nucleare, 1968. (In Italian).

From Symposium on Problems Bearing on Isotope Separation of Uranium, Turin, Italy. See CONF-681015.

A new thermodynamic-based theory of isotope separation was developed which responds to the following criteria: It is valid both for gases and liquids, as well as for gas–liquid mixtures; it takes into consideration the irreversibility of the phase transformation due to the internal friction of the fluids; and the final formula does not contain correction factors of an empirical nature. Initial studies showed that in order to interpret the motion of a fluid it is necessary to take into consideration the integral characteristics of the system, both geometric and thermodynamic. The theory developed gives the solution as a function of the thermodynamic irreversibility of the outflow. (J.S.R.)

50074 SURFACE DIFFUSION EFFECT IN GASEOUS DIFFUSION. Fiocchi, R. (Univ., Milan). pp 73-83 of Problemi della Separazione Isotopica dell'Uranio. Roma, Comitato Nazionale Energia Nucleare, 1968.

From Symposium on Problems Bearing on Isotope Separation of Uranium, Turin, Italy. See CONF-681015.

Results of a theoretical study of surface diffusion effects on separation efficiency in gaseous diffusion are presented. The validity of various theories is tested by comparison of predicted results with those obtained experimentally for isotopic mixtures of diatomic and monoatomic molecular gases, multiatomic molecular hydrocarbons, and UF_6. The status of experimental separation programs to test theories is reviewed. (J.R.D.)

50075 OPTIMISATION OF DIFFUSION PLANT OPERATION. Avery, D. G.; Gunton, R. R.; Steele, G. E. (United Kingdom Atomic Energy Authority, Risley, Eng.). pp 87-110 of Problemi della Separazione Isotopica dell'Uranio. Roma, Comitato Nazionale Energia Nucleare, 1968.

From Symposium on Problems Bearing on Isotope Separation of Uranium, Turin, Italy. See CONF-681015.

An analysis of methods available to the UK for production of sufficient enriched U during the next five years is presented. Plans for future extensions to minimize total expenditures on enrichment capacity and U feed material to meet the expanding requirements through the 1970's are described. (J.R.D.)

50076 OPTIMIZATION OF SQUARE AND SQUARED-OFF CASCADES FOR URANIUM ENRICHMENT BY GASEOUS DIFFUSION PROCESS. Higashi, Kunio; Saito, Toru; Doi, Hideo; Oishi, Jun (Kyoto Univ.). pp 111-28 of Problemi della Separazione Isotopica dell'Uranio. Roma, Comitato Nazionale Energia Nucleare, 1968.

From Symposium on Problems Bearing on Isotope Separation of Uranium, Turin, Italy. See CONF-681015.

An approximate formula is proposed for use in optimization of square and squared-off cascades. A broad flexibility is noted in determination of intermediate compositions of the mole fractions of the lighter isotope in product, feed, and waste. The size of the optimum m-steps squared off cascade are obtained by calculating the mole fractions of the lighter isotope in product, feed, and waste. Equations are also given for obtaining the overall separation factor in the i-th step and the number of stages in each step. It is concluded that in most cases the number of steps (fewer than 5) may be sufficient in an enriching section as well as in a stripping section. (J.R.D.)

50077 DETERMINATION OF THE SEPARATION PROPERTIES OF GASEOUS DIFFUSION BARRIERS USING NONISOTOPIC GAS MIXTURES. Martensson, M. (Aktiebolaget Atomenergi, Stockholm). pp 145-72 of Problemi della Separazione Isotopica dell'Uranio. Roma, Comitato Nazionale Energia Nucleare, 1968.

From Symposium on Problems Bearing on Isotope Separation of Uranium, Turin, Italy. See CONF-681015.

Basic aspects of porous barriers used for isotope separation by gaseous diffusion are considered. Relations between the microstructure of barriers and barrier properties that can be observed directly are analyzed. A method for testing porous barrier is described which is convenient for exploratory investigations. The method also rapidly shows changes in compositions of gases in which the molecular weight rather than the isotopic mass is the basis of separation. (J.R.D.)

50078 DESCRIPTION OF AN EXPERIMENTAL INSTALLATION FOR THE MEASUREMENT OF THE CHARACTERISTICS OF BARRIERS FOR GASEOUS DIFFUSION. Martin, J. C.; Bailly, R.; Arbez, C.; Lerat, J. M. (CEN, Saclay, France). pp 173-9 of Problemi della Separazione Isotopica dell'Uranio. Roma, Comitato Nazionale Energia Nucleare, 1968. (In French).

From Symposium on Problems Bearing on Isotope Separation of Uranium, Turin, Italy. See CONF-681015.

An experimental facility, defined as the absolute pilot, for the measurement of the characteristics of barriers for gaseous diffusion is described. The range of parameters it permits to be covered seem definitively sufficient for furnishing to the contractor all the data necessary for the optimization of plants. The pilot installation can function continuously and thus furnish more reliable information than its predecessors. (tr-auth)

50079 REFLECTIONS ON A CONVERSION PLANT FOR CONCENTRATING URANIUM IN UF_6 AND RECONVERTING THE UF_6 TO ENRICHED UO_2: CONNECTIONS WITH AN EVENTUAL PLANT FOR ISOTOPIC SEPARATION ON A LARGE SCALE. Donato, M. (Commissione delle Comunita Europee, Brussels). pp 183-96 of Problemi della Separazione Isotopica dell'Uranio. Roma, Comitato Nazionale Energia Nucleare, 1968. (In Italian).

From Symposium on Problems Bearing on Isotope Separation of Uranium, Turin, Italy. See CONF-681015.

The problems of the long-term supply of enriched uranium and the availability of a European enrichment plant have long been the objects of study by international organizations. An analysis is presented of the existing situation and the desirability of a European enrichment installation that is based on studies by individual members of the Comunita Europee on the construction of a U enrichment plant. The plants and processes used in the United States and Europe for the transformation of concentrates into UF_6 and of enriched UF_6 into UO_2 are summarized. The characteristics of isotopic separation plants and their auxiliary installations are outlined. The relative investments for enrichment plants and auxiliaries are indicated. (J.S.R.)

50080 THE INFLUENCE OF A THIRD COMPONENT ON THE CENTRIFUGAL SEPARATION OF THE URANIUM ISOTOPES. Los, J. (FOM-Instituut voor Atoom en Molecuulfysica, Amsterdam). pp 239-45 of Problemi della Separazione Isotopica dell'Uranio. Roma, Comitato Nazionale Energia Nucleare, 1968.

From Symposium on Problems Bearing on Isotope Separation of Uranium, Turin, Italy. See CONF-681015.

It is shown that addition of a third component to isotopic mixtures of U being separated by centrifugation leads to loss of separative power unless the mass diffusion effect is used by giving the isotopic mixture and the third component opposite radial velocities. (J.R.D.)

50081 SOME CONSIDERATION REGARDING THE DESIGN AND THE OPERATION OF AN ULTRA-CENTRIFUGE ENRICHMENT FACILITY. Bogaardt, M.; Theyse, F. H. (Reactor Centrum Nederland, Amsterdam). pp 265-74 of Problemi della Separazione Isotopica dell'Uranio. Roma, Comitato Nazionale Energia Nucleare, 1968.

From Symposium on Problems Bearing on Isotope Separation of Uranium, Turin, Italy. See CONF-681015.

Considerations important in design of uranium separation facilities based on the ultracentrifuge are discussed. Information is included on projected plant capacity, demand for enriched uranium, ultracentrifuge development and experience, ultracentrifuge plant costs, and ultracentrifuge technology growth rates. (J.R.D.)

50082 RE-ENTRY SAFETY OF ISOTOPIC SYSTEMS. Kahn, Stewart F.; Dohner, Clark V. (General Electric Co., Philadelphia). Contract AT(29-2)-2581. J. Spacecraft Rockets, 6: 939-41(Aug. 1969).

Results are presented of an aerothermal-structural reentry safety evaluation for the SNAP-27 (56-W(e)) radioisotope graphite lunar module fuel cask at both orbital and superorbital velocities. The evaluation shows that the cask possesses positive thermal and thermal stress margins under all abort modes. Design requirements for the recovery of the fuel from a 5-kW(e) Large-Heat-Source system are compared with the SNAP-27 system. (D.L.C.)

50083 ON SOME PROBLEMS OF THE ECONOMICAL PROFIT IN USING ISOTOPIC AND RADIATION TECHNIQUES. Purtova, M. I. Isotopenpraxis, 5: 209-20(June 1969). (In German).

Fundamental methodical problems are discussed for the technological and economic expediency of the development and introduction of methods and procedures of isotopic and radiation techniques. Examples for investigations of this kind as well as for the economical profit of using isotopic and radiation techniques in the U.S.S.R. industry are given. (auth)

Materials Testing

Refer also to abstracts 49933, 49995, 50043, 50051, 50198, 50978, 51038, and 51054.

50084 (ANL-7172) USE OF THE CONDUCTING MASK IN PULSED ELECTROMAGNETIC TESTING. Cox, C. W.; Renken, C. J. (Argonne National Lab., Ill.). Apr. 1969. Contract W-31-109-eng-38. 34p. Dep. CFSTI.

The application of conducting masks to the problem of nondestructive testing by means of pulsed electromagnetic fields was studied. The diffusion of a pulsed plane wave into a semi-infinite conductor was calculated, and formulas were derived for pulse attenuation and delay, as well as for field strength inside and outside the conductor. The plane-wave assumptions cause serious discrepancies between calculated and experimentally measured fields through conducting sheets. A qualitative analysis of the symmetrical mask offers a satisfactory explanation for most of the experimentally observed features of its operation, and provides an insight into the operation of other types of masks. (auth)

50085 DEFECTOSCOPIC DOLLY FOR INSERTION OF RADIOACTIVE EMITTER INTO PIPING. Baran, M. Strojirenstvi, 19: 302(May 1969).

The invention is described for a defectoscopic dolly for the central gamma photography of piping welds, with an independent solution for stability of position, especially suitable for checking piping welds in gas and oil pipelines. (JPRS)

Radioactive Material Handling

Refer also to abstract 49892.

50086 (AAEC/TM-510) DESIGN AND TESTING OF TYPE B PACKAGING FOR SMALL MULTI-PURPOSE ISOTOPE TRANSPORT CONTAINERS TO THE REQUIREMENTS OF THE INTERNATIONAL ATOMIC ENERGY AGENCY. Miles, J. G.; Rolland, J. M.; Shaw, C. D. G. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). July 1969. 12p. Dep. CFSTI (U. S. Sales Only).

Packaging for four types of small multi-purpose isotope transport containers has been designed and tested in accordance with the requirements of the IAEA regulations for the Safe Transport of Radioactive Materials, Safety Series No. 6 (1967). The containers were shielded by 2 inches of lead; 3 inches of lead; 4 inches of lead; and 2⅝ inches of depleted uranium. The designs have been approved by the relevant Australian Competent Authorities for use as Type B packaging, for sea and air transport. (Australia)

50087 (ANL-Trans-777) EFFLUENT TREATMENT AT THE MARCOULE PLUTONIUM PRODUCTION CENTER. Ruiz Sanchez, F. Translated for Argonne National Lab., Ill., from pp 35-41 of Compte Rendu du Ier Colloque Franco-Espagnol sur le Traitment des Combustibles Irradies, Fontenay-aux-Roses, France, 11-14 Novembre 1967. 11p. (CONF-671143-1). Dep. CFSTI.

The effluents of the Marcoule Center with an activity between 10^{-4} and 10 μCi/ml are separated into three groups, the two most active of which are chemically treated. The long-lived fission products which they contain (Sr, Cs, Ce, Zr, Nb, Ru) are coprecipitated or absorbed in amounts of 80 to 98% for ruthenium and 99 to 100% for the other elements. The sludges formed consist of calcium carbonate, ferrous hydroxide, nickel ferrocyanide, lead paraperiodate, or manganese dioxide; they are directly coated with bitumen which provides excellent storage safety. Treated effluents are discharged into the Rhône where they remain at a level of a few percent of the permissible safety specifications. (auth)

50088 (BNL-13867) SERVO TELEMANIPULATORS AND THEIR PRESENT AND FUTURE APPLICATIONS. Flatau, Carl R. (Brookhaven National Lab., Upton, N. Y.). [nd]. 27p. (CONF-690213-1). Dep. CFSTI.

From Colloquium on Current and Future Developments in Teleoperator Technology and Applications, Denver, Colo.

A manipulator is described which was designed for use at high-energy accelerators, and specifically at Brookhaven. The communication link between the master and slave is described. Applications of servo-manipulators may be included in space exploration. Telemanipulating systems might be applied to coal mining and avoid hazardous disasters to humanity by loss of lives or health. However, to do this, the major problems to be hurdled are social and economic, not technical. (J.C.W.)

50089 (BNWL-1186) RESEARCH AND DEVELOPMENT ACTIVITIES: FIXATION OF RADIOACTIVE RESIDUES. Quarterly Progress Report, May-July 1969. Blasewitz, A. G. (ed.) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Aug. 1969. Contract AT(45-1)-1830. 26p. Dep. CFSTI.

Twenty-three radioactive demonstrations in WSEP have been completed with simulated wastes containing approximately 32 MCi of mixed radionuclides being converted to solids. Approximately 2.6 MCi of radioactivity were processed in the tenth spray solidification run, and approximately 2.7 MCi were processed in the seventh phosphate glass run. Spray solidification Run SS-10 processed a simulated Purex Waste 4m (PW-4m). It was the last in the first series of spray solidification runs, and completed that phase of the Waste Solidification Demonstration program which established the basic engineering feasibility of all three solidification processes. Although the spray solidification system is certainly not optimized, the performance data have shown that major processing factors can be adequately controlled. Phosphate glass Run PG-7 was a simulated Purex Waste 2 (PW-2) and is the first in the final series of phosphate glass demonstrations. The PW-2 glass effective thermal conductivity of 0.9 W/(m²) (°C/m) during air storage increased to 1.85 W/(m²) (°C/m) when most of the glass was molten during the pot filling operation in the receiver furnace. Development spray solidification runs indicated that more than 95% of the ruthenium can be retained in the calcine from PW-4m feeds over a range of acidities if the phosphate flux is not added to the feed. Three Distillation Demonstration Unit (DDU) runs have been made using sulfate containing condensate from phosphate glass solidification Run PG-4. At operating pressures of 30 mm Hg and lower, the sulfuric acid fraction can be distilled with a low nitric acid content and with a ruthenium content corresponding to a DF of greater than 200, a value large enough to permit incorporation of the sulfuric acid in asphalt for permanent storage. Vacuum distillation of the melter condensate has been shown on engineering scale equipment to be a viable concept for decontamination of the sulfuric acid fraction. (auth)

50090 (CEA-R-3742) USE OF A THIN-FILM EVAPORATOR FOR BITUMEN COATING OF RADIOACTIVE CONCENTRATES. Lefillatre, Guy; Rodier, Jean; Hullo, Raoul; Cudel, Yvonne; Rodi, Lucienne (Commissariat a l'Energie Atomique, Chusclan (France). Centre de Production de Plutonium de Marcoule). July 1969. 29p. (In French). Dep. CFSTI (U. S. Sales Only).

A technological study of a process for coating evaporation concentrates with bitumen has been undertaken. A pilot installation for the bitumen coating of concentrates, which uses a thin-film evaporator LUWA L 150, is described. The first inactive series of tests was designed to determine the maximum and optimum capacities of the evaporator by varying the amounts of bitumen and of concentrate, the rotor speed, and the thermo-fluid temperature. Two rotors were tested, one of conventional type, the other a model especially designed for high viscosity products. The maximum capacity of evaporation of the apparatus was 72 kg/hr for a heating temperature of 221°C. During normal operation, the evaporator can produce 50 kg/hr of coated product containing 55 to 60% of bitumen (Mexphalte 40/50), the water content of the product remaining under 0.5%. A second series of tests will shortly be carried out on this pilot installation using, in particular, bituminous emulsions containing mainly Mexphalte 40/50 and 80/100. (auth)

50091 (DPSPU-69-124-1) PACKAGING OF RADIOACTIVE AND FISSILE MATERIALS. Safety Summary Report: LMF Cask. Rogers, R. F. (comp.) (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Plant). Aug. 1969. Contract AT-(07-2)-1. 116p. Dep. CFSTI.

Stainless steel- or aluminum-clad cobalt-60 is shipped in LMF casks in compliance with AEC Manual Chapter 0529 (AECM 0529), Safety Standards for the Packaging of Radioactive and Fissile Materials. The shipment does not represent a hazard under normal or accident conditions. The design of the cask is given. (auth)

50092 (DPSPU-69-124-2) SAFETY SUMMARY REPORT: BISMUTH CASK (PACKAGING OF RADIOACTIVE AND FISSILE MATERIALS). Rogers, R. F. (comp.) (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Plant). Sept. 1969. Contract AT(07-2)-1. 65p. Dep. CFSTI.

Irradiated aluminum-clad bismuth slugs, containing polonium-210, are shipped completely or partially immersed in water in a stainless steel cask that is normally pressurized. The cask has solid stainless steel walls that provide radiation shielding and is designed to retain the water coolant in an accident. A shipment is nominally 250,000 curies of ^{210}Po, but varies with seasonal variations in maximum air temperature (which governs the heat load that the cask can carry). In all cases, the cask is loaded so as not to exceed an internal pressure of 138 psig and a coolant temperature of 360°F while in transport under normal conditions. (auth)

50093 (KFK-906) EFFECTIVITY AND COST OPTIMIZATION OF SAFEGUARDS SYSTEMS. Avenhaus, R.; Gupta, D. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). Mar. 1969. 32p. (In German). Dep.

Two models for a safeguards system with flow measurement were studied on the basis of testing hypotheses for the amount of diverted fissile material. From the mathematical standpoint it is noted that these tests were adjusted only with respect to the costs which they themselves cause and not the losses (positive or negative) which they cause. One system is called the inspector's system in which the inspector can detect a diversion by observation and surveillance and the model is based on the theory of games. The other is a statistical model based on the flow measurements of fissile material at strategic points. The expressions developed for the probability of detection, error first and second kind, cost functions, and effectivity for the two systems are tabulated. (J.C.W.)

50094 (UJV-2097-Ch) FIXATION OF CONCENTRATED WASTES IN CEMENT BY THE METHOD OF VACUUM EXHAUSTION FROM CEMENT-WATER MIXTURES. Napravnik, J.; Verner, M. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). Nov. 1968. 16p. (In Czech.). Dep. CFSTI (U. S. Sales Only).

A new method is given for the fixation of concentrated radioactive wastes into cement, namely that of vacuum exhausting water from a cement-water mixture that yields a solid cement block. The vacuum procedure has been tested on a pilot plant scale and compared with the cementation method presently in use in Saclay. The vacuum method eliminates the application of a vacuum rotation filter, filter press, or a centrifuge. The reported method of the vacuum cementation provides for very low cement-water ratios (≤35 at 0°) that imply the low elution of incorporated radioactive species by water. Both the low elution and considerable hardness of the solidified blocks enable their storage without metallic or other encasement. The surface protection of blocks by plastic paints is under consideration. (auth)

50095 (WASH-1141) SAFEGUARDS AND NUCLEAR MATERIALS MANAGEMENT. An Annotated Bibliography of Selected Literature. Inman, Guy M. (comp.) (Office of Safeguards and Materials Management (AEC), Washington, D. C.). Oct. 15, 1969. 44p. Dep. CFSTI.

A total of 213 references to unclassified reports, journal articles, conference papers, and other literature pertinent to Safeguards and Nuclear Materials Management is included. The material was taken from that appearing in Nuclear Science Abstracts from January 1, 1965 to July 30, 1969. The references are arranged according to the subjects listed in the table of contents. Personal author, report number, and corporate or issuing agency indexes are provided. (auth)

50096 FIREPROOF SHIELDED CONTAINERS FOR RADIOACTIVE MATERIALS. Blum, Paul (to Societe Lyonnaise de Plomberie Industrielle). U. S. Patent 3,466,662. Priority date Oct. 21, 1964, France.

In a container designed for radioactive materials, with an inner casing, a lead screen closely surrounds the casing. Between the lead screen and a steel outer shell is an intermediate space filled with plaster (hydrated calcium sulfate) to form a refractory protective heat-insulating and water containing layer. The cover of the container may also comprise a layer of plaster between its lead screen and its outer plate. (Offic. Gaz.)

50097 SELF-SUFFICIENT NUCLEAR DECONTAMINATION SEMI-TRAILER. Roussiaux, P. Rev. Alumin., No. 368, 1031-4 (Nov. 1968). (In French).

A decontamination semi-trailer built in France for use in the event of accidents involving radioactive contamination is described. The semi-trailer and equipment weigh 10 tons and measure 11 m by 3.2 m by 3.5 m. It consists of a dressing room, four showers, a control and operations room, an exit lock, and a room containing a 12 kVa generator, water storage and pump system, water heater, turbo air blowers, and filtered air turbo extractors. The body of the trailer is of duralinox alloys and consists of A-SG alloy reinforcements, anodized A-G3 alloy panels for the outer cladding, and varnished A-G3 alloy for the inner cladding with a roof in painted A-G3 alloy sheets. (TSS) (Sum. Articles Fr. Tech. Press)

50098 INDUSTRIAL WASTE DISPOSAL. Ross, R. D. New York, Reinhold Book Corp., 1968. 340p. $16.00.

Following an analysis of waste disposal problems in general and consideration of the basic engineering principles and unit processes applicable to these problems, the following are discussed: waste gas treatment, waste liquid treatment, incineration, final disposal, radioactive waste management, and air and water pollution regulations. The information on waste gas and liquid treatment describes: air pollution control by mechanical methods, condensers, activated carbon adsorption, vapor phase systems; methods of pretreating waste liquids, treatment of dilute waste water, and ion exchange systems. (Occup. Safety and Health Abstr.)

50099 PROCESS AND APPARATUS FOR THE COMBUSTION AND EVAPORATION OF RADIOACTIVE RESIDUES. Amavis, Rene; Krawczynski, Stefan; Vanuzzi, Sergio (to EURATOM). British Patent 1,163,099. Sept. 4, 1969. Priority date Feb. 18, 1966, Belgium.

The method and equipment used in a process for burning and evaporating radioactive residues is described. The apparatus consists of a burner which projects into a post-combustion chamber with an outlet for hot gaseous combustion products. This outlet leads directly into an evaporator chamber or into a heat exchanger which has a further outlet into the evaporator chamber for gas heated by exchange with the combustion products. The burner operates at a minimum temperature of 1100°C and the post-combustion chamber at 900°C. The heat released by the combustion of radioactive residues is used to evaporate other liquid radioactive residues. The evaporation may be affected by direct contact between the gaseous combustion products and the other residues or by indirect heating using the heat exchanger. (L.C.L.)

50100 METHODS FOR THE INTERNATIONAL ATOMIC ENERGY AGENCY SAFEGUARDS APPLICATION FOR A NUCLEAR POWER STATION OF THE HWGCR TYPE WITH PRESSURE VESSEL. Drahny, Milos; Novak, Stainslav (Power Research Inst., Prague). Jad. Energ., 15: 329-34(Oct. 1969). (In Czech).

Problems in the application of IAEA fissionable materials safeguards to power reactors of the Czechoslovakian A-type (HWGCR) are discussed. The problems described relate to characteristics of the A-type plants, the basic safeguards supervision approach, and possible inspection methods acceptable to both the plant operator and IAEA requirements. (auth)

50101 FIASCHERINO LABORATORY STUDIES ON RADIOACTIVE CONTAMINATION OF SEA. Bernhard, Michael. Com. Naz. Energ. Nucl., Notiz., 14: 72-87(Nov. 1968). (In Italian).

A brief description is given of the scope of work undertaken by the Fischerino Laboratory for studying the effects of radioactive waste disposal on contamination of the sea. The organizational arrangement of departments at the Laboratory (physics, chemistry, geology, botany, zooplankton, ichthyological, microbiology, special instrumentation, etc.) and at collaborating laboratories and institutions is given, and methods for handling and transporting radioisotopes and radioactive waste for marine disposal are described. (R.V.J.)

50102 CAISSON FOR CONNECTION TO HOT CELLS. Samsel, Gerard; Werner, Paul; Karman, Julien; Ferring, Ernest (to EURATOM). British Patent 1,166,389. Oct. 8, 1969. Priority date Aug. 22, 1966, Germany.

A caisson with a removable cover is described for use at the openings of hot cells. The caisson effects a seal with the chamber walls around the opening. The caisson is of sufficient size to allow the hot cell door to be removed and stored inside providing a passageway from the caisson to the hot cell. Experimental structures can be transferred in and out of the hot cell using the caisson. (J.R.D.)

Vacuum Engineering

Refer also to abstract 50219.

50103 (RFP-1345) CO-AXIAL WATER-COOLING FEEDTHROUGHS FOR HIGH VACUUM PROCESSES. Van Vorous, T.; Bowdey, R. Donald; Hammit, O. C. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). Aug. 13, 1969. Contract AT(29-11)-1106. 11p. Dep. CFSTI.

A group of co-axial water-cooling feedthroughs was designed for use in high vacuum processes. The feedthroughs may be assembled into several configurations, may be insulated for high voltage applications, and have been assembled from readily available components. (auth)

50104 THE TURBO-MOLECULAR PUMP: A MODERN MEANS FOR PRODUCING CLEAN ULTRAHIGH VACUA. Kelly, J. W. (Australian Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Aust. Phys., 16: 99-102(July 1969).

The turbo-molecular pump has been developed following renewed interest in the molecular drag pump. The principles and early forms of molecular drag pumps are described. Pumps based on Becker's design which uses the principles of the axial flow compressor have speeds up to 4000 liters/sec. Design trends include increase in rotor speed and change of blade shape. Hydrocarbon-free atmospheres can be maintained at 10^{-4} to 10^{-5} torr and a vacuum of about 10^{-9} torr can be obtained without using cold traps. The pump has a low pumping speed for its size and is costly when compared with the getter-ion and trapped diffusion pump. It has applications in plasma work, Van de Graaff accelerators, and surface and environmental physics. (Australia)

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstracts 49980 and 51258.

General Detectors and Monitors

Refer also to abstracts 50182, 50254, 50521, 50657, 50659, 50725, 51040, 52076, 52288, and 52329.

50105 (BNWL-1051(Pt.2), pp 173-6) FOLDING OF DISTRIBUTIONS. Roesch, W. C. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

A rapid and efficient method was developed for performing the folding process for the summing of Poisson series that appear in the theories of local energy density and of charged-particle energy straggling. (auth)

50106 (BNWL-1051(Pt.2), pp 176-83) ENERGY ABSORPTION STRAGGLING. Roesch, W. C.; Glass, W. A. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The theory of multiple energy losses of charged particles is studied and then applied to experimental data on the energy loss distributions of protons in thin layers. A discussion of delta-ray losses from thin layers is given. (auth)

50107 (BNWL-1051(Pt.2), pp 191-3) PRELIMINARY INVESTIGATION OF THE RADIAL EXTENT OF PROTON TRACKS. Glass, W. A.; Braby, L. A.; Roesch, W. C. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Distributions of the energy deposited by delta rays from 1.7 MeV protons in a cylindrical absorber and also outside the absorber are presented. (W.H.K.)

50108 (BNWL-1051(Pt.2), pp 194-6) WALL-LESS DETECTOR FOR MEASURING ENERGY DEPOSITION SPECTRA. Glass, W. A.; Braby, L. A. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

A wall-less detector for measuring energy deposition spectra is described. The main characteristics of the detector are: the volume from which ionization is collected is defined without the use of solid walls, the sensitive volume is nominally spherical, the gas multiplication occurring near the surface of the anode is independent of where the primary ionization occurred within the sensitive volume, and the gas multiplication factor is in excess of 10^3 so low energy events can be accurately recorded. (B.G.D.)

50109 (BNWL-1051(Pt.2), pp 205-6) A METHOD TO ELIMINATE THE REDUCED COUNTING EFFICIENCIES AT THE ENDS OF TRAVEL FOR SCANNING TYPE WHOLE BODY COUNTERS. Palmer, H. E.; Langford, J. C. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

In order to eliminate this problem, a travel distance of 6 ft 6 in. was selected as the maximum height of people that would be counted. A count rate profile was then constructed by placing a uniformly distributed source of ^{137}Cs along this distance and counting it with the detector at 1 in. intervals from one end to the other. At each end position, the center of the detector was directly over the end of the distributed source. From this count rate profile, a speed profile was then calculated for the detector which would compensate for this end effect. The speed profile is shown and a 6 ft 6 in. long cam of the profile was constructed alongside the counter. A linear variable potentiometer was installed to ride along the cam at the same linear position as the detector. The voltage across the potentiometer controls the speed of the stepping motor which moves the detector and changes the speed at the ends so that for every linear section of the body the product of efficiency times the counting time is the same. (B.G.D.)

50110 (BNWL-1051(Pt.2), pp 207-12) TWO-DIMENSIONAL SCANNING WHOLE BODY COUNTER. Langford, J. C.; Griffin, B. I.; Palmer, H. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The investigation of the properties of a whole body counter in which the detector oscillates laterally simultaneously with the longitudinal transport of the body has led to the discovery of a mechanical function generation. The motion, as above, generates a function which eliminates the effect of geometry (converts $1/r^2$ to a constant) and converts the exponential absorption relation to a linear function for isotopic, symmetric media. This will allow simplified computer methods of data treatment to be used in data analysis where this motion is used to accurately integrate the data and also to locate the X-Y-Z positions of a radionuclide within absorbing media. (auth)

50111 (CEA-BIB-169) NOTE CONCERNING THE USE OF SILICON PHOTO-DIODES IN A SCINTILLATOR DETECTOR. Verdant, Robert (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Aug. 1969. 33p. (In French). Dep. CFSTI (U. S. Sales Only).

A literature survey is presented which establishes the conditions under which it is possible to use a silicon photo-diode in conjunction with a scintillator. The main parameters involved are discussed including spectral response, sensitivity, noise and optical coupling. The results obtained by different workers are summarized and compared. The prospects of a development in association with collection or charge-multiplier diodes are considered. Finally an attempt is made to define the practical limits to the use of the device; this appears to be the spectrometry of heavy charged particles above a certain energy. (auth)

50112 (CEA-CONF-1339) SOME RECENT WORKS IN THE FIELD OF FAST NUCLEAR ELECTRONICS. Mey, J. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). [1969]. 25p. (CONF-690629-1). Dep. CFSTI (U. S. Sales Only).

From Seminar on Nuclear Electronics, Varna, Bulgaria.

Work has been related to the elaboration of a modular system including the major functions which are necessary in nuclear physics experiments that require fast electronics. This system has been built on an industrial scale. It is capable of repetition rates up to 100 MHz. This speed is sufficient for present particle detectors. Efforts are being directed towards the improvement of some special features in high-speed analysis and processing of counters signals such as timing, high-precision time measurement, amplification, signal-to-noise ratio, and dc restoration. Research is being performed to increase the speed of logic circuits up to frequencies of the order of 1 GHz. (auth)

50113 (CEA-R-3782) AUTOMATIC DEVICE FOR MEASURING β-EMITTING SOURCES: P.A.P.A. β METERS. Colomer, Jean; Valentin, Michel (Commissariat a l'Energie Atomique, Bruyeres-le-Chatel (France). Centre d'Etudes). June 1969. 34p. (In French). Dep. CFSTI (U.S. Sales Only).

The apparatus described is designed for measuring β-emitting elements by the absorption method; it is suitable for carrying out a large number of routine analyses. A mechanical device pushes an aluminium absorption set automatically between the source and the detector; the movement is programmed for cutting on and off by a transistorized electronic unit, with printing out and punching of the results on tape; this can then be mathematically processed by a computer (tracing of absorption spectra, extrapolation and calculation of the activity). The detector is either a β-probe or a proportional counter with a specially designed loop. For routine measurements, the accuracy obtained, with all corrections made, is from 5 to 8%; the reproducibility is about 2%. (auth)

50114 (CLOR-74) EXTRAPOLATION IONIZATION CHAMBER. Roman, J.; Sawicka, B. (Centralne Laboratorium Ochrony Radiologicznej, Warsaw (Poland)). 1969. 15p. Dep. CFSTI (U. S. Sales Only).

Construction and operation of variable-spacing parallel-plate ionization chamber are described. It has been designed mainly for the measurement of beta dose rate. This chamber allowed measurement of beta dose rate in the range from few tenths of rad/h to several hundreds of rad/h with an accuracy of 10%. (auth)

50115 (INR-972) PROCESS OF CHARGE COLLECTION IN SILICON DRIFTED DETECTORS WITH UNHOMOGENEOUS DISTRIBUTION OF ELECTRIC FIELD. Moszynski, Marek (Institute of Nuclear Research, Warsaw (Poland)). 1968. 130p. (In Polish). Dep. CFSTI (U. S. Sales Only).

On the basis of the investigation of the time spread and the shape of pulses from silicon drifted detectors it has been found that the distribution of the electric field in the detector is represented by a second order polynomial. An analysis of the charge collection process based on the postulated electric distribution has been carried out. The resulting theoretical pulse shape is in good agreement with the experimental one. The calculated and experimentally determined time spreads are of the same order of magnitude, while the earlier theory of charge collection in the detector with the uniform electric field predicts 40 times lower time spreads. (auth)

50116 (INR-1089) CALIBRATION OF LOGARITHMIC RATE METER. Gasiorowski, Leslaw (Institute of Nuclear Research, Warsaw (Poland)). 1969. 30p. (In Polish). Dep. CFSTI (U. S. Sales Only).

Sequent phases of calibration of a Cooke–Yarborough's logarithmic rate meter are described, and the influence of scaling points on the distribution of errors along the instrument scale is discussed. The utilization of the measured characteristic of errors distribution for final calibration points selection is proposed. The influence of current summing resistor values on the error distribution is considered and for illustration of this dependence, a number of calculated curves is shown. The error compensation by means of saturation current choice of the border pumps is proposed. (auth)

50117 (INR–1097) USE OF THE SOLID STATE PARTICLE TRACK DETECTORS IN REACTOR MEASUREMENTS. Jozefowicz, Krystyna (Institute of Nuclear Research, Warsaw (Poland)). 1969. 13p. Dep. CFSTI (U. S. Sales Only).

Dielectric track detectors can be used for neutron detection by registering charged particles from interactions of neutrons with matter. Fission fragments as well as light recoil atoms and alpha-particles can be recorded and distinguished in some polymers. The use of particle track detectors in reactor measurements by (n,f) and (n,α) reactions and recoil atoms is discussed. The results of measurements of fast neutron flux relative distributions in WWR-SM cores are shown in comparison with sulphur activation results. Further possibilities of the method for absolute and spectral neutron measurements are pointed out. (auth)

50118 (NYO–3738-15) DIGITAL WIDE RANGE NEUTRON DETECTION AND MEASUREMENT CHANNEL. (Milletron, Inc., Pittsburgh, Pa.). June 9, 1969. Contract AT(30-1)-3738. 78p. Dep. CFSTI.

A Digital Wide Range Neutron Detection and Measurement Channel to continuously monitor the neutron flux from 0.025 to 2.5×10^8 nv is described. Over this range the count rate is monitored from 1 to 1×10^{10} cps. The reactor period is monitored from neutron fluxes of 2.5×10^2 nv, which corresponds to 10,000 counts per second up to the capacity of the instrument at 20 billion cps. The wide range is obtained by means of a detector assembly that provides three ranges of detection. These ranges are integrated into the counting circuits so as to span the 11 digits of level display. The low-range detector measures from 0 to 10^6 cps; the mid-range, from 5×10^5 to 1×10^8 cps; and the high-range above 5×10^7 cps. The switching of ranges is entirely dependent upon the level of operation of the unit and takes place only following determination of the reactor period. This range switching involves gating of the input signal and high voltage supply to the detectors. The rate of change of neutron flux is given by the period meter. Level and period trip circuits are provided which indicate when the count level is too high or rate of change is too rapid. An internal self-checking circuit is designed to ascertain that the counting circuits are operating for all three ranges and that the period circuits are functioning. The pass or fail condition is indicated visually by panel lamps and by relay contacts. (J.C.W.)

50119 (RFP–1166) INEXPENSIVE AIR PROPORTIONAL ALPHA DETECTOR. Johnson, Valens P.; Griep, Victor R. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). Sept. 25, 1969. Contract AT(29-1)-1106. 4p. Dep. CFSTI.

An air proportional alpha detector has been developed which is more resistant to contamination, humidity, breakage, and microphonics than other earlier designs. An easily replaced and disposable screen results in a savings of many man-hours spent previously in screen decontamination. (auth)

50120 (UCRL–18667, pp 331-42) ELECTRONIC INSTRUMENTATION AND SEMICONDUCTOR DEVICES. (California Univ., Berkeley. Lawrence Radiation Lab.).

Topics include the development of a germanium counter system for charged-particle nuclear spectroscopy, germanium detector system development, computer control system for the field-free spectrometer, control unit for linking pulse-height analyzers to a PDP-9 computer, and a special-purpose computer for linking pulse-height analyzers with a digital incremental plotter. (W.H.K.)

50121 (UCRL–19270) RADIATION-RESISTANT CHROMIUM-ACTIVATED ALUMINUM OXIDE SCINTILLATOR. Allison, Robert W. Jr.; Brokloff, Robert W.; McLaughlin, R. L.; Richter, Robert M.; Tekawa, Marsh; Woodyard, John R. (California Univ., Berkeley. Lawrence Radiation Lab.). July 16, 1969. Contract W-7405-eng-48. 7p. Dep. CFSTI.

Chromium-activated radiation-resistant scintillators have been produced by anodizing aluminum in a sodium tetraborate solution to which potassium dichromate had been added. These scintillators have been used in a 250-A 3.4-MeV 300-nsec electron beam, with no noticeable radiation damage. Tests have also been done with 5-GeV protons, with similar results. (auth)

50122 (UCRL–50007-69-1) HAZARDS CONTROL PROGRESS REPORT NO. 33, JANUARY–APRIL 1969. (California Univ., Livermore. Lawrence Radiation Lab.). 64p. Dep. CFSTI.

Separate abstracts were prepared for six of the 10 papers presented. Papers on a mercury vapor generator, electric conductivity of foams, opacity and composition of smokes, and reactivity of LiH with H_2O were not abstracted for NSA. (W.H.K.)

For abstracts of individual papers see: 50123–50126, 50176, and 50483.

50123 (UCRL–50007-69-1, pp 1-5) TRITIUM PROPORTIONAL COUNTER WITH GAMMA COMPENSATION. Block, S.; Barlow, O. M.; Dixon, J. E.; Hodgkins, D. J. (California Univ., Livermore. Lawrence Radiation Lab.).

A portable tritium monitor was developed that can operate in gamma radiation fields up to 5 mR/hr and detect 1 MPC of HTO. (auth)

50124 (UCRL–50007-69-1, pp 14-18) TEMPERATURE DEPENDENCE OF A PLUTONIUM X-RAY SURVEY INSTRUMENT. Hoeger, T. O.; Tinney, J. F. (California Univ., Livermore. Lawrence Radiation Lab.).

Temperature response data are presented for several components in the plutonium x-ray survey instruments presently being used at LRL. (auth)

50125 (UCRL–50007-69-1, pp 19-21) IN VIVO DETECTION OF ^{90}Sr FROM BREMSSTRAHLUNG WITH THIN NaI(Tl) CRYSTAL DETECTORS. Lindeken, C. L.; Anderson, A. L. (California Univ., Livermore. Lawrence Radiation Lab.).

Preliminary measurements using water phantoms indicate a strontium-90 detection sensitivity of about 1/20 of a body burden (bone). (auth)

50126 (UCRL–50007-69-1, pp 22-6) THE DETECTION OF TRITIATED WATER USING A PLASTIC-SCINTILLATOR FLOW CELL. Prevo, C. T.; Santomassimo, V. C. (California Univ., Livermore. Lawrence Radiation Lab.).

A plastic-scintillator flow cell was designed and evaluated as a tritiated-water detector. (W.H.K.)

50127 (UCRL–71679) DEFECT STUDY AND IDENTIFICATION IN Ge(Li) P–N JUNCTION RADIATION DETECTORS. Armantrout, G. A. (California Univ., Livermore. Lawrence Radiation Lab.). Sept. 3, 1969. 33p. (CONF-690821–1). Dep. CFSTI.

From Electronic Materials Conference, Boston, Mass.

Ge(Li) detectors, which are very high resolution gamma-ray spectrometers, are extremely sensitive to defects in the junction of the detector. These defects act as charge-trapping centers and seriously degrade the detector performance. Several techniques, which include the detector monochromatic infrared response, reverse current characteristics, and performance analysis have been used to study these defects. The results indicate that degradation of the detector spectrum is due both to detector inhomogeneities and traps. The main inhomogeneity is caused by a localized variation in the precipitation rate of lithium, which results in weak detector collection fields and heavier localized trapping. The properties of copper, nickel, and iron as traps indicate that the presence of lithium modifies the trap behavior by shielding the Coulomb force and by shifting the deep-trap energy states. The most important traps are those due to lithium effects. The precipitate phase of lithium behaves as a hole trap with a distributed energy level system. A separate lithium phase involving the complex formation of lithium with thermal defects results in an electron trap with an energy position located at $E_c - E_t = 0.22$ eV. (auth)

50128 NUCLEAR ELECTRON INSTRUMENTS IN FRANCE. COOPERATION BETWEEN INDUSTRY AND CEA. Duquesnoy, J. (CEA, Saclay, France). Atomwirt., Atomtech., 14: 294-8 (June 1969). (In German).

The cooperation between the CEA and industry has led to significant development in the field of nuclear electronics. The most important advances made in radiation detectors and their associated electronics are briefly outlined. In radiation detectors the most important developments have occurred in semiconductor detectors. Developments described include Li-drifted Ge detectors, Li-drifted Si detectors, diodes for neutron measurements, and large-surface detectors. The developments discussed in the detector-associated electronics are the Renatran input series, system for concentration and transmission of alphanumerical data, input for fast electronics, the CAMAC input system, and devices for numerical processing of nuclear data. (J.S.R.)

50129 DEVICE FOR STUDYING COSMIC RADIATION AT 200 TO 400 km ELEVATION. Maduev, V. L.; Makhmudov, B. M.; Pisarenko, N. F. Vestn. Mosk. Univ., Ser. III. Fiz. Astron., No. 4, 79-82(July-Aug. 1969). (In Russian).

A device for cosmic radiation measurements is described.

The design, recording, and calibration of the instrument are analyzed. (R.V.J.)

50130 TECHNICAL METHODS FOR RADIATION PROTECTION. APPLICATION TO REACTORS. Fitoussi, L. pp 249-93 of Genie Atomique. Tome II. Saclay, France, Institut National des Sciences et Techniques Nucleaires. Paris, Presses Universitaires de France, 1968. (In French).

The general techniques of protection against external irradiation and radioactive contamination are summarized. The general techniques for the detection of radiation in radioprotection are considered from the viewpoint of external radiation and internal contamination. The principles of radioprotection for reactors are summarized. (J.S.R.)

50131 DETECTION OF RADIATIONS. Oria; Moreau. pp 135-58 of Genie Atomique. Tome II. Saclay, France, Institut National des Sciences et Techniques Nucleaires. Paris, Presses Universitaires de France, 1968. (In French).

In pulse electronics, the factors to be considered are the pulse, the amplification chain, pulse analysis, and pulse counting. These are discussed. Detectors using ionization phenomena and scintillation detectors are discussed in some detail. (J.S.R.)

50132 POSITRON SCANNING. Brownell, Gordon L. (Massachusetts General Hospital, Boston). pp 3-19 of Advances in Dynamic Radioactive Scanning. Wang, Yen (ed.). Springfield, Ill., Charles C Thomas Publisher, 1968.

Resolution and collimation, source absorption, brain-tumor scanners, positron-emitting isotopes, and new positron scanning and camera techniques are discussed. (W.H.K.)

50133 INFORMATION-THEORY APPLICATIONS IN RADIOISOTOPE SCANNING. Robertson, James S. (Brookhaven National Lab., Upton, N. Y.). pp 20-7 of Advances in Dynamic Radioactive Scanning. Wang, Yen (ed.). Springfield, Ill., Charles C Thomas Publisher, 1968.

The use of information theory for optimizing the resolution of radioisotope scanners is discussed. The activity and distribution of the isotope, detector efficiency and collimation, reliability of electronic circuits, and interpretation of the scan are briefly considered. (W.H.K.)

50134 THYROID SCANNING USING THE GAMMA CAMERA. Wang, Yen (Univ. of Pittsburgh. Presbyterian-Univ. Hospital, Pittsburgh. St. Francis General Hospital, Pittsburgh). pp 28-37 of Advances in Dynamic Radioactive Scanning. Wang, Yen (ed.). Springfield, Ill., Charles C Thomas Publisher, 1968.

The contrast and resolution of a gamma camera were investigated. The study was carried out with a Picker thyroid phantom, a 3- by 2-inch sodium iodide-crystal Magnascanner, and Anger's gamma camera. Two patients with thyroid nodules were also studied. (B.G.D.)

50135 AN IMAGE-TUBE ISOTOPE CAMERA FOR USE WITH LOW-ENERGY PHOTON EMITTERS. Ter-Pogossian, Michael M. (Washington Univ., St. Louis). pp 38-43 of Advances in Dynamic Radioactive Scanning. Wang, Yen (ed.). Springfield, Ill., Charles C Thomas Publisher, 1968.

A radioisotope camera for low-energy gamma or x radiation is described. The camera employs a nuclear image-converter tube and an orthicon television display. (W.H.K.)

50136 HIGH-RESOLUTION ELECTRONIC GAMMA-RAY IMAGING. Sternglass, Ernest J.; Keller, Eldon L. (Westinghouse Research Labs., Pittsburgh). pp 44-71 of Advances in Dynamic Radioactive Scanning. Wang, Yen (ed.). Springfield, Ill., Charles C Thomas Publisher, 1968.

Gamma cameras incorporating x-ray image intensifiers and TV-camera tubes are capable of attaining improved resolution over that of existing devices. To avoid excessive radiation doses, it is shown that maximum utilization of the available quanta is required and that short-lived, low-energy gamma emitters can be effectively used. Resolution and sensitivity are then limited by the statistical fluctuation of the detected gamma quanta. Technical considerations governing the choice of the camera tube for such a system are discussed, and it is shown that the SEC-camera tube is most versatile and capable of recording low-contrast images. Experiments using the system with Siemens star patterns indicate that its sensitivity and resolution were approaching the limitations imposed by statistical fluctuations. The technique is also applicable to x-radiography permitting dose rates at the image detector only slightly greater than those due to normal background radiation. (auth)

50137 POSSIBLE APPLICATIONS OF THE IMAGE-SCANNING SYSTEM. Wang, Yen (Univ. of Pittsburgh). pp 72-80 of Advances in Dynamic Radioactive Scanning. Wang, Yen (ed.). Springfield, Ill., Charles C Thomas Publisher, 1968.

An image-scanning x-ray or gamma-ray camera which can be used with short-life isotopes in the range 20 to 150 keV is described. (B.G.D.)

50138 DIRECT MEASUREMENT OF QUALITY FACTOR AND DOSE EQUIVALENT. Sullivan, A. H. (CERN, Geneva). pp 60-3 of Proceedings of the Conference on Radiation Protection in Accelerator Environments, Chilton, England, March 1969. Stevenson, G. R. (ed.). Chilton, Eng., Rutherford Laboratory, 1969.

See CONF-690320.

The problems involved in making an estimation of the hazard from unknown mixtures of ionizing radiation are discussed and the techniques that have been developed to make a direct estimation of dose equivalent and quality factor of radiation are reviewed. It is shown from theoretical considerations that a device based on measurement of initial recombination of ions in a gas has a response as a function of LET that is near to that necessary to conform to the ICRP recommended dependence of QF on LET. (auth) (UK)

50139 LET SPECTROSCOPY. Day, B. (Atomic Weapons Research Establishment, Aldermaston, Eng.). pp 64-8 of Proceedings of the Conference on Radiation Protection in Accelerator Environments, Chilton, England, March 1969. Stevenson, G. R. (ed.). Chilton, Eng., Rutherford Laboratory, 1969.

See CONF-690320.

The concept of LET and its significance in radiological protection are discussed together with a brief outline of some methods of measuring the LET spectrum of a radiation field. The use of a spherical proportional counter, similar to that first proposed by Rossi, to measure LET spectra is described in detail. The development of this device and its application to measurements in high energy radiation environments are also described. The steps taken to make a portable version of the spectrometer are outlined. (auth) (UK)

50140 DOSE AND DOSE EQUIVALENT ESTIMATION FROM BROAD NEUTRON SPECTRA. Shaw, K. B.; Stevenson, G. R. (Rutherford Lab., Chilton, Eng.). pp 69-77 of Proceedings of the Conference on Radiation Protection in Accelerator Environments, Chilton, England, March 1969. Stevenson, G. R. (ed.). Chilton, Eng., Rutherford Laboratory, 1969.

See CONF-690320.

The estimation of dose and dose-equivalent based on the use of activation techniques is described. It is shown that provided these detectors give a true measure of flux density then the dose equivalent, defined in any reasonable way, can be obtained from a two detector system with reasonable accuracy in broad neutron spectra. (auth) (UK)

50141 USE OF STANDARD RADIATION SURVEY INSTRUMENTS IN PULSED RADIATION FIELDS. Leake, J. W. (Atomic Energy Research Establishment, Harwell, Eng.); White, D. F. pp 103-10 of Proceedings of the Conference on Radiation Protection in Accelerator Environments, Chilton, England, March 1969. Stevenson, G. R. (ed.). Chilton, Eng., Rutherford Laboratory, 1969.

See CONF-690320.

The use of standard radiation survey instruments in pulsed radiation fields is discussed in terms of the type of detector used in the instrument. The limitations on the range of dose rates over which an instrument using a pulse type detector may be used without serious error, and the effects of an additional steady radiation component to the pulsed field in imposing further limitations are derived. It is shown that instruments using a mean current ionization chamber may be used without serious error at exposure rates up to N^2 R/h, where N is the repetition frequency of the pulsed radiation. Nomographs are given which enable an operator to determine quickly the errors and limitations involved in the use of a given instrument in any particular radiation field, assuming that the performance of the instrument in a continuous radiation field is known. (auth) (UK)

50142 HEALTH PHYSICS INSTRUMENTATION FOR ACCELERATORS. Perry, D. R.; Hack, R. C. (Rutherford Lab., Chilton, Eng.). pp 111-13 of Proceedings of the Conference on Radiation Protection in Accelerator Environments, Chilton, England, March 1969. Stevenson, G. R. (ed.). Chilton, Eng., Rutherford Laboratory, 1969.

See CONF-690320.

Instruments and detector systems used around the 7 GeV proton synchrotron Nimrod are described, including some general requirements for accelerator health physics equipment. (auth) (UK)

50143 OPERATIONAL HEALTH PHYSICS AT THE 4 GeV ELECTRON SYNCHROTRON NINA. Coleman, F. J. (Daresbury Nuclear Physics Lab., Eng.). pp 121-35 of Proceedings of the

Conference on Radiation Protection in Accelerator Environments, Chilton, England, March 1969. Stevenson, G. R. (ed.). Chilton, Eng., Rutherford Laboratory, 1969.
See CONF-690320.

Health Physics precautions associated with the high energy accelerator NINA (National Institute Northern Accelerator) are discussed. The fixed monitor system, which continuously monitors the stray radiation around the site, is described, together with the special instrumentation and methods necessary to measure the mixed high energy radiation field near the experimental areas. Included is a description of the Personnel Safety System and the classification of Radiation Controlled Areas. The machine-OFF conditions include measurements of the induced activity in the vacuum system and assessment of the possible hazards of noxious gases and active air to personnel entering the machine just after switch-off. Also described are some typical machine-ON radiation conditions. (auth) (UK)

50144 MEASUREMENT OF THE FAST NEUTRON SPECTRUM IN WATER REACTOR WITH THE USE OF THRESHOLD DETECTORS. McFarlin, W. A. (Texas A and M Univ., College Station); Weng, P. S. Ho Tsu K'o Hsueh, 6: No. 3-4, 71-8 (Apr. 1969).

The threshold detector technique was used to determine the fast differential neutron energy spectrum, and the improved flux-integral method was applied for solving the linear integral equation that governs the relationship between the neutron flux and the induced activity of the threshold detector. The step function method and the polygonal method were also applied for solving the linear integral equation with the aid of an IBM 7094 computer. The results of measurement were compared with a spectrum obtained from a similar reactor. The comparison was satisfactory. (auth)

50145 THE USE OF ^{184}W AS A THERMAL FLUX MONITOR AT HIGH TEMPERATURES. Ball, Lauren L.; Richardson, Paul J.; Sheibley, Dean W. (Lewis Research Center, Sandusky, Ohio). Nucl. Appl. Technol., 7: 393-6(Oct. 1969).

Tungsten-184 is a useful dosimeter for thermal neutrons, particularly for high temperature applications. Correlation of neutron flux with cobalt-59 activation and uranium-235 fission density for short-term irradiations is shown. The tungsten-184 thermal neutron capture cross-section in the Plum Brook Reactor was found to be 1.94 ± 0.08 barns. Cadmium ratios for tungsten-184 are about one-fifth of the value found for cobalt-59 in differing spectral regions of the reactor. The radiochemistry and counting techniques for tungsten-185 are described. (auth)

50146 CONTROL TOWER AND METHOD FOR PROGRAMMING AUTOMATIC RADIOACTIVITY MEASURING SYSTEM. (to Beckman Instruments Inc.) British Patent 1,167,203. Oct. 15, 1969. Priority date Apr. 11, 1966, United States.

A programming system for an automatic radioactivity measuring system including a sample conveyor containing at least two links and a counting index position is described. The programming system has a control tower which can be coded with information to select a desired program of two or more steps and positioned in a link of the conveyor in front of at least one other link for which it is intended to set up the program. A tower reader assembly is located at the index position for detecting and distinguishing between the presence of a tower or a sample and reading the information coded on the tower, and a memory is connected to the assembly for storing the information and utilization circuits are included to effect the program. (auth)

50147 RADIATION DETECTOR SOUNDS OFF. Walters, Eugene. Electron. World, 82: 76-7(Aug. 1969).

The new personal monitor for nuclear radiation workers, which is described, is small enough for a shirt or jacket pocket and provides a loud audible warning when radiation levels increase above a preset limit. The monitor uses a special ultraminiature G-M detector, with a relatively low-cost tube. A simplified block diagram of the personal radiation monitor is given; the alarm tone generator is activated by a signal from a high-voltage supply oscillator to an audio amplifier. This action produces a characteristic chirping sound through the speaker, the monitor's way of warning the user that radiation is present. Since a personal monitor must have a wide operating temperature range, Si transistors are used except for 1 Ge type. Extra reliability is possible with circuit modifications. Sensitivity can be changed. A certain amount of neutron sensitivity is built into the monitor. (BBB)

50148 LARGE DIAMETER GAMMA CAMERA. Bio-Med. Eng., 4: 80-1(Feb. 1969).

A γ camera for production of an almost instantaneous monochrome picture of the distribution of γ radiation from radioactive tracers in the body was described for revealing tumors in the liver, kidney, brain, and thyroid. The 9½-in. dia camera had a larger crystal than previous models and could therefore view a larger area of the body. Multiple shots were not needed when a larger image was required. An additional attachment was used to increase the size of the image. A color television display was provided. The TV camera was pointed at the black and white scintigram taken from an oscilloscope display. A color conversion unit then translated the variations of light intensity into different colors. With a little tuning, a tumor could be revealed on the television screen in a color contrasting with the background. Improvements have been made in this color TV display. Previously, separate colors could be distinguished but this contrast was too coarse for some work. An infinite range of colors was theoretically obtained. With the new display, these were resolved by the eye into 8 different tones. Its ability to translate intensities of black and white in monochrome images into separate colors was applied in other areas of medicine. In displaying conventional x rays 2 different color guns were used, and the display was viewed with special spectacles. In this way a 3-dimensional image was visible. (BBB)

50149 LOADED LIQUID SCINTILLATORS USING 1,6-DIMETHYL- AND 1-METHYLNAPHTHALENE AS SOLVENTS. Koike, Yuji; Yamamoto, Kakuji (Tokyo Metropolitan Isotope Research Center). Jap. J. Appl. Phys., 8: 1266(Oct. 1969).

The quenching effect by loaded materials can be eliminated by using 1,6-dimethylnaphthalene and 1-methylnaphthalene as both solvent and intermediate solvent. This solvent effect was studied using 2,5-diphenyloxazole, 9,10-diphenylanthracene, and 1,6-diphenylhexa-1,3,5-triene as solvents and B, Cl, and P as loading elements. Pulse heights are shown as a function of trimethylborate concentration, and half-value concentrations (for which initial pulse height is reduced by a factor of 2) are presented for all the loaded scintillators. (D.L.C.)

50150 DETECTION OF WEAK BETA EMITTERS BY LIQUID SCINTILLATION COUNTING TECHNIQUES. II. PHENOMENA OBSERVED IN THE PRESENCE OF GASES IN LIQUID SCINTILLATION SYSTEMS. Toeroek, G.; Nagy, L. G.; Szarvas, T. (Polytechnic Univ., Budapest). Period. Polytech. Chem. Eng., 12: 229-44(1968).

A method is described for the determination of carbon dioxide labeled with ^{14}C by means of liquid scintillation counting techniques in which Hyamine 10-X was used. According to results obtained, the counting system was highly unstable in the first 1.5 to 2 hr, the deviation of the pulse heights being in the order of 30 to 35%. After this period the efficiency was stabilized at the starting value. Experiments with other gases (ethylene and ammonia) dissolved in the pure scintillator, also showed the effect on modifying quantum efficiency, but this effect was less than with CO_2. According to the concept formulated, these gases or their compounds may also be directly or indirectly excited, and thus take part in energy transfer. This concept is supported by some spectroscopic data. (BBB)

50151 SELECTIVITY OF X-RAY DETECTION BY A VARIABLE GEOMETRY PROPORTIONAL COUNTER. Cairns, J. A.; Holloway, D. F.; Desborough, C. L. (Atomic Energy Research Establishment, Harwell, Eng.). Nature (London), 223: 1262-3(Sept. 20, 1969).

Disadvantages of the conventional side window gas flow proportional counter for detection of x-rays are pointed out. There is usually some difficulty in placing the counter sufficiently close to specimens in a vacuum system to obtain the greatest collection efficiency; in addition, the distance between the window and anode is fixed, and in order to obtain the best effective gas path length for low energy x-rays it is often necessary to operate the counter at reduced pressure, and the gas pressure must be more strictly stabilized to prevent fluctuations in voltage output. The counter described is of the end window type, and therefore may be conveniently positioned close to targets in a vacuum system. The window can also be interchanged simply. Capacitance is reduced by having the head amplifier built inside the counter body, allowing the monitoring of very soft x-rays. The resolution and performance are comparable with that of a good side window counter. The anode can be positioned at various distances from the window, while the counter is operating, and can be conveniently replaced. X-ray spectra forming a composite CU/Si target for three anode settings are reproduced. (UK)

50152 SOME FACTORS IN X-RADIATION DETECTION WITH THE SCINTILLATION COUNTER. Reed, Dorothy J. (Dept. of Energy, Mines, and Resources, Ottawa). Can. Spectrosc., 14: 119-24(Sept. 1969).

When the scintillation counter is used to detect the K radiation of elements of atomic number 57 and greater, the escape peak may

play an important role in the establishment of the parameters to be used for the measurement of X-ray intensity. Double plateaus are found and pulse amplitude curves become complex, especially for second and third order radiation. A shift in pulse amplitude with counting rate has been found for a scintillation counter using XP1010 photomultiplier tubes. This shift makes the choice of a threshold for the pulse height analyzer critical. (auth) (Canada)

50153 THE PRESENT STATE OF APPLICATION OF LIQUID SCINTILLATION COUNTING. RESULTS OF A QUESTIONAIRE. Simon, H.; Rauschenbach, P. (Technische Hochschule, Munich). Int. J. Appl. Radiat. Isotop., 20: 725-31(Oct. 1969). (In German).

A questionaire, comprising 31 points concerning liquid scintillation, was circulated to 127 laboratories. Liquid scintillation counting is mostly used in biochemistry, medicine, organic chemistry and biophysics. On average, 1400 samples are measured per month. Thirty-seven percent are tritium, 41% carbon-14, 16% others and 6% double labelled samples. The different scintillation systems, sample preparation methods, and procedures for counting yield determinations are given according to their frequency. The quench correction is mainly responsible for the total average error of ±6.1%. The method of internal standard is considered to be the most accurate of 7 different procedures. Fifty-nine percent of the applicants are interested in radio chromatographic measurements, using a liquid scintillation counter. Such measurements are applied only in 8% of the laboratories. (auth) (UK)

50154 DETECTION OF PARTICLES BY SCINTILLATION. Blanc, D.; Commanay, L.; Teyssier, J. L. (Univ., Toulouse). Onde Elect., 49: 796-803(July-Aug. 1969). (In French).

Without dealing with the photomultiplier techniques, the inorganic (solid and liquid) and gaseous scintillators are reviewed. The scintillators' place in the field of practical applications is that which the proportional counters and Geiger–Mueller counters held fifteen years ago. The scintillation mechanism, the application of inorganic crystals to soft x-ray spectrometry, the application of liquid materials to physical dosimetry, and wider studies of gaseous scintillators are discussed. (auth)

50155 MEASUREMENT OF TRANSIT TIME FLUCTUATION OF PHOTOMULTIPLIERS. Vallat, D. Onde Elect., 49: 804-9 (July-Aug. 1969). (In French).

Electron transit time in a photomultiplier is subject to fluctuations which were evaluated experimentally. The determination was made by noting arrival time of impulse issued from a single photoelectron, with regard to a referring signal. (auth)

50156 SPURIOUS ALARMS OF DIGITAL RADIATION MONITORING. Plesch, R. (Siemens AG, Karlsruhe, Ger.). Atompraxis, 15: 253-6(July-Aug. 1969). (In German).

Development of automatic pulse scalers with preset measuring and pause intervals and adjustable threshold provides the possibility of carrying out continuous radiation monitoring in a digital manner. Either the expected number of spurious alarms or the meantime interval between two spurious alarms is calculated. The values so obtained become more advantageous if only spurious alarms of higher order are permitted. By assuming the probability for the appearance of a true alarm the detection limit of the method can be evaluated as a function of the background radiation. Finally, the standard deviations of the calculated values are treated. (auth)

50157 DETERMINATION OF THE FLUX DENSITY OF THERMAL TO SLOW NEUTRONS BY MEASUREMENTS WITH A MINIATURE BF_3 COUNTER. Piroth, H. D. (Philipps-Univ., Marburg, Ger.). Atompraxis, 15: 265-8(July-Aug. 1969). (In German).

A procedure for estimating the flux density of thermal to slow neutrons originating in the irradiation of a water phantom with the dimensions of a human torso is described. The neutron source is a Van-de-Graaff-generator which uses the $T(d,n)^4He$ nuclear reaction for producing 14.5 MeV neutrons which are primarily almost monoenergetic. (auth)

50158 EFFICIENCY AND TIME RESOLUTION OF 120cm³ Ge(Li) DETECTOR. Henck, R.; Siffert, P.; Miehe, J.; Coche, A. (Centre de Recherches Nucleaires, Strasbourg). Nucl. Instrum. Methods, 74: 169-70(1969). (In French).

The characteristics (resolution, full-energy peak efficiency, pulse rise times) of a 120 cm^3 Ge(Li) γ-ray detector are described. The time resolution obtained at 0.511 and 1.33 MeV was respectively 8 and 5.4 nsec. (auth)

50159 EVOLUTION OF SCINTILLATION SCANNING. Cassen, Benedict (Univ. of California, Los Angeles). pp 3-14 of Clinical Scintillation Scanning. Freeman, Leonard M.; Johnson, Philip M. (eds.). New York, Harper and Row, Publishers, 1969.

The development of radioisotope scanning procedures is reviewed. Emphasis is placed on the development of scintillation detectors, photomultipliers, collimators, gamma cameras, and labeled compounds. The diagnostic value of radioisotope scanning as a nondestructive and nontraumatic method of acquiring clinical information on patients is discussed. (53 references.) (C.H.)

50160 INSTRUMENTATION AND PORTRAYAL OF INFORMATION. Beck, Robert N. (Univ. of Chicago. Argonne Cancer Research Hospital, Chicago). pp 15-49 of Clinical Scintillation Scanning. Freeman, Leonard M.; Johnson, Philip M. (eds.). New York, Harper and Row, Publishers, 1969.

At the present state of the art of radioisotope imaging, neither scanners nor cameras produce an image with an information density approaching that of ordinary diagnostic x ray systems, primarily because of the high spatial resolution of the latter. The technique is nevertheless of value because it provides a different kind of information, that is related to organ function as well as structure. Both the sensitivity and spatial resolution of radioisotope imaging systems are limited primarily by the collimator, the design of which is always based on a compromise between these parameters. For example, collimators that would preserve the intrinsic spatial resolution of image-intensifier tubes would be prohibitively inefficient, although advances continue to be made toward the utilization of these devices. On the other hand, the Anger camera represents a very useful combination of intrinsic spatial resolution and detector sensitivity, and can be collimated in many ways for different applications. In addition, the energy resolution of this device is comparable to that of other scintillation detectors, so that some scattered radiation can be rejected. In general, collimator efficiency is proportional to the area of the detector for which it is designed. A focused collimator designed for a large-diameter crystal of a scanner provides good resolution only near the focal distance; i.e., it has a short depth of field. A multichannel parallel-hole camera collimator designed for a crystal with the same diameter provides best resolution at the collimator face and worse resolution with increasing distance from the collimator; the result is a relatively great depth of field. The depth of field that is required depends on the source thickness and the possible value of tomographic views. At present, for many applications, the best spatial resolution with usable sensitivity can be obtained with a scanning system, while highest sensitivity with usable spatial resolution can be obtained with camera systems. In the future, the hybrid systems such as those proposed by Harper and Anger may combine the versatility of a scanner (the area viewed is not limited by the crystal size), the sensitivity of a large detector area, and a choice between a single image with great depth of field and multiple tomographic views. (72 references.) (auth)

50161 THE USE OF ABSOLUTE ACTIVITY FOR ELIMINATING SERIOUS ERRORS IN THE MEASUREMENT OF PRIMARY PRODUCTIVITY WITH ^{14}C. Goldman, Charles R. (Univ. of California, Davis). J. Cons. Perma. Int. Explor. Mer, 32: 172-9 (Nov. 1968).

The use of barium carbonate for calibrating the G–M counting equipment routinely used in primary productivity studies in marine and fresh waters has resulted in serious errors. Because the radioactivity of algae rather than barium carbonate is being measured, algae are the best radioactive source for determining the efficiency of G–M counting. The absolute activity of any particular thickness of filtered algae as well as that of a ^{14}C label can be accurately determined in gas phase. This direct procedure eliminates tacit assumptions of self-absorption and backscattering effects in calibration. The G–M counting efficiencies of algae varied with species to species and with sample weight. The marine diatom Skeletonema was found to have a particularly low counting efficiency. (BBB)

Nuclear Spectroscopic Instrumentation

Refer also to abstract 50191.

50162 (BNWL-1051(Pt.2), pp 118-21) THE EFFICIENCY CALIBRATION OF A LARGE-VOLUME Ge(Li) GAMMA-RAY SPECTROMETER. Cooper, J. A.; Jackson, A. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The relative and absolute efficiency functions for a large volume Ge(Li) gamma-ray spectrometer are reported for a point source at various distances from the detector. (auth)

50163 (BNWL-1051(Pt.2), pp 121-7) EVALUATION OF Ge(Li) COMPTON SUPPRESSION SPECTROMETERS FOR RADIOCHEMICAL ANALYSIS. Cooper, J. A. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Three types of Ge(Li) Compton suppression spectrometers are

discussed and evaluated relative to their application to the problems facing the analytical radiochemist. (auth)

50164 (NP-tr-1852) APPLICATION OF THE PURE FLEXION OF CRYSTAL PLATES IN CRYSTAL HOLDERS FOR FOCUSSING X-RAY SPECTROGRAPHS. Gilvarg, A. B. Translated for Culham Lab., Abingdon, Eng., from Dokl. Akad. Nauk SSSR, 77: 489-91(1950). 5p. (CTO-643). Dep. CFSTI (U. S. Sales Only).

A new method of bending crystal plates for x-ray spectrographs which involves the pure bending of a rectangular crystal plate on a circular cylindrical surface by applying two equal bending moments of opposite sense to the two ends of the plate is described. (W.H.K.)

50165 (UCRL-71825) NUCLEAR SPECTROSCOPY VIA Ge(Li) DETECTORS IN COMPTON SUPPRESSION AND PAIR SPECTROMETERS. Camp, David C. (California Univ., Livermore. Lawrence Radiation Lab.). Sept. 12, 1969. 92p. (CONF-690818-6). Dep. CFSTI.

From International Conference on Radioactivity in Nuclear Spectroscopy, Nashville, Tenn.

In the six years that lithium-drifted germanium detectors have been available, the range of scientific disciplines and problems to which they have been applied has become vast and broad. The Ge(Li) detectors used for these experiments are primarily of four types and sizes, and these are discussed briefly. The relatively small volume of these detectors with their corresponding small peak-to-total and peak-to-Compton ratios has led to various combinations of Ge(Li), NaI(Tl), and plastic scintillation detectors which are designed to reduce the Compton distribution. The resulting configurations vary from novelties to highly successful spectrometers. A review of the various configurations, their effectiveness, relative performance, and cost is discussed. The importance of Compton suppression and pair spectrometers in nuclear spectroscopy is now realized, and examples are given which highlight the advantages of both types of spectrometers. The electronic logic of such systems has a bearing on the amount of continuum suppression obtained, and the essentials are discussed. Designs for two future systems are discussed, the first offering a much higher efficiency and the second a peak-to-Compton ratio approaching 1000 to 1 for ^{60}Co. (auth)

50166 IMPROVEMENTS IN OR RELATING TO RADIATION MEASURING APPARATUS. Hick, Harald Peter; Rumpold, Karl (to Osterreichische Studiengesellschaft fuer Atomenergie GmbH). British Patent 1,166,890. Oct. 15, 1969. Priority date Nov. 4, 1966, Austria.

Coincidence circuits and semiconductor detectors are described for a Compton gamma spectrometer. (W.H.K.)

50167 CALCULATED PARAMETERS OF WIDE-RANGE CHARGED-PARTICLE MAGNETIC SPECTROGRAPH. Basargin, Yu. G. Zh. Tekh. Fiz., 38: 2091-4(Dec. 1968). (In Russian).

Ion-optical spectrograph parameters with a pulse overlap of 2.6 : 1 were calculated using the fringe effect of the vertical focusing and by compensating partially for the aberration of motion in the median plane. (tr-auth)

High Energy Physics Instrumentation

Refer also to abstracts 51830, 51869, and 51870.

50168 (NP-17995) CONTROL IN REAL TIME BY MEANS OF IBM 1800 TABLES OF MEASUREMENT FOR BUBBLE CHAMBER PHOTOGRAMS. Internal Note No. 219. Bagella, G. F.; Orlandini, A.; Rambaldi, A. (Rome Univ. (Italy). Istituto di Fisica. Istituto Nazionale di Fisica Nucleare, Rome (Italy)). Apr. 29, 1969. 23p. (In Italian). Dep. CFSTI (U. S. Sales Only).

A system was devised for the control in real time of the measurement of bubble chamber photographs, using an IBM 1800. The system is briefly described, and the measurement procedure is outlined. The controls exercised on the event are analogous to those of the THRESH geometry program and are described. The program is outlined with a description of the program of initiation, operational program in response to interruption, control program, and data punch card program. Appendices outline the priority levels, describe TITOLO, ECO-type digital output, data-imput form, and the scope of the data which can be transmitted to the program. (J.S.R.)

50169 INTERACTION OF HEAVY IONS IN MATTER. Kobetich, Edward John. Lincoln, Nebr., Univ. of Nebraska, 1968. 146p.

Thesis.

The spatial distribution of ionization energy about the path of a rapidly moving ion has been shown to be the parameter essential for describing the response of several media to heavy ion bombardment. To accommodate electron scattering and other problems arising in the calculation of this distribution, a simple empirical formulation was developed for the energy dissipation of normally incident electron beams onto slabs, in agreement with complex formulations and experimental data, over a wide range of energies and materials. Successful application was made to three detection and damage phenomena. In these applications, the response of the media is taken to be characterized as a one-hit or a many-hit (threshold) process; the media are taken as homogeneous; a point target approximation is used; and the characteristic energy dosage is treated as an adjustable parameter. Values for this parameter range from 10^4 to 10^9 ergs/cm^3, as appropriate to the characteristic "sensitive volume" for the process. A model proposed for the response of NaI(Tl) to heavy ions yields relative pulse heights in agreement with experimental data for ions of $Z > 5$ at 1 – 10 MeV/amu, when the characteristic energy dosage is 4×10^7 ergs/cm^3. The model proposed for the formation of etchable tracks in dielectric media predicts the formation or nonformation of etchable tracks in Lexan polycarbonate, cellulose nitrate, and mica, in agreement with published data. The model proposed for the width of ion tracks in emulsion gives excellent agreement with measured profiles for residual ion ranges less than 3000μ ($\beta < 0.3$). In view of the continuing search for magnetic poles, calculations based on these models have been made to establish criteria for pole detection using NaI(Tl), dielectric, or emulsion detectors. (Disser. Abstr.)

50170 A CONTRIBUTION TO THE CALCULATION OF THE HIGH VOLTAGE PULSE AT A SPARK CHAMBER. Allkofer, O. C.; Weinert, M. (Univ., Kiel). Nucl. Instrum. Methods, 174: 173-5(1969).

The time behavior of a spark chamber pulse is calculated by means of a simple equivalent circuit. This model is a base to determine the characteristic values of the spark chamber trigger circuit. (auth)

50171 DEVELOPMENT STUDY ON LUMINESCENT CHAMBER. [PART] 2. Machida, Shoji; Tsushima, Itsuro (Yamanashi Univ., Kofu, Japan). Yamanashi Daigaku Gakugeigakubu Kenkyu Hokoku, No. 19, 234-7(1968). (In Japanese).

In the previous paper, a report was made on the luminescent chamber employing a dynode multi-stage image intensifier tube. Using the improved tube, the photon multiplication has reached a point at which photographing is possible, and the tracks of cosmic rays in the NaI(Tl) crystal have been observed by photography. The track of fast cosmic ray particles was not continuous, but rather seen as several spots. This is probably due to the distribution of light production along the track within the NaI(Tl). The number of such spots was about 3/cm in the crystal, roughly $\frac{1}{3}$ of the expected value. The time delay of square-wave pulses was 0.4 μsec, and the loss of light amount on the fluorescent surface due to the delay was about $\frac{1}{2}$. If the width of the square waves is 150 μsec, the whole amount of available light is taken. The spot due to the noise within the time interval was 0.1. The S-type deformation decreased with increase of the supplied voltage. (NSA of Japan)

Radiation Dosimeters

Refer also to abstracts 50107, 50114, 50122, 50455, 50528, 52379, and 52425.

50172 (AWRE-O-57/69) A PORTABLE LET SPECTROMETRY SYSTEM FOR THE CALIBRATION OF THE CONCORDE RADIATION METER. Day, B. (Atomic Weapons Research Establishment, Aldermaston (England)). Aug. 1969. 34p. Dep. CFSTI (U. S. Sales Only). UK 5s. 0d.

The development of a LET spectrometry system weighing 70 lb is described. The system uses two detectors, one of which is an ion chamber which measures total absorbed dose. The distribution of absorbed dose in LET is determined with a spherical proportional counter used in the manner first described by Rossi. The responses of the two detectors can be combined to yield the mean quality factor (QF) and Dose Equivalent (DE) of radiation fields of unknown composition. It is shown that air is a satisfactory filling for proportional counters at the low pressures used. By the use of air, the weight of the gas supply for the counter has been greatly reduced compared with existing systems. Distributions of absorbed dose in LET obtained with the system are shown for neutrons over the energy range 0.5 to 20 MeV. (auth)

50173 (BNWL-1051(Pt.2), pp 184-6) ENERGY ABSORPTION SPECTRA IN A UNIFORM MEDIUM. Braby, L. A.; Roesch, W. C.; Glass, W. A. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

An experiment to determine the spectral shift resulting from a density difference between the walls and the gas of a gas proportional counter is described. The spectrum produced in a solid-wall counter is compared with the spectrum produced in a similar counter in which there was no difference in density between the gas and the wall. (W.H.K.)

50174 (BNWL-1051(Pt.2), pp 186-90) ENERGY ABSORPTION DISTRIBUTIONS IN A CYLINDER OF UNIT ELONGATION FOR MONOENERGETIC PROTONS. Glass, W. A.; Braby, L. A. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The energy deposition spectrum of 1.7 MeV protons in a cylindrical absorber of unit elongation and 0.25 μ diameter is presented. It is seen that the energy deposited by protons is not locally concentrated along the track. The mean energy deposited along various chord lengths and the straggling distributions show effects that can be explained only on the basis of rather large amounts of energy being deposited by δ-rays. (W.H.K.)

50175 (ORNL-TM-2687) AN INSTRUMENT THAT PROVIDES LINEAR TEMPERATURE RAMPS FOR USE WITH TSEE EXPERIMENTS. Thorngate, J. H. (Oak Ridge National Lab., Tenn.). Oct. 1969. Contract W-7405-eng-26. 17p. Dep. CFSTI.

An electronic circuit was designed and tested that provides a temperature which increases as a linear function of time for use in experiments being conducted at the DOSAR Facility. A thermocouple in close proximity to the sample measures the temperature. This signal is compared with a linearly increasing voltage produced by charging a capacitor with a fixed current. The difference between the two voltages is amplified and provides the operating current for the heater. Heating rates adjustable from 0.5 to 10°C/sec are possible. The maximum temperature attainable and the maximum heating rate are adjustable, but are limited by the available output of the heater supply and the characteristics of the heater. Temperature ramps linear to within 1% were obtained over a temperature range from 75 to 750°C at heating rates from 1 to 10°C/sec. (auth)

50176 (UCRL-50007-69-1, pp 27-34) LRL PARTICIPATION AT THE 5th OAK RIDGE NUCLEAR ACCIDENT DOSIMETRY INTERCOMPARISON. Griffith, R. V.; Kase, K. R. (California Univ., Livermore. Lawrence Radiation Lab.).

Results are reported of LRL criticality dosimetry measurements at the ORNL Nuclear Accident Dosimetry Intercomparison. (auth)

50177 MONITORING OF THE INDIVIDUAL IN ACCELERATOR ENVIRONMENTS. Marshall, T. O.; Knight, A. (Radiological Protection Service, Belmont, Eng.). pp 78-90 of Proceedings of the Conference on Radiation Protection in Accelerator Environments, Chilton, England, March 1969. Stevenson, G. R. (ed.). Chilton, Eng., Rutherford Laboratory, 1969.

See CONF-690320.

A brief survey of the different types of accelerators in use within the United Kingdom is given, and the requirements associated with individual monitoring in the environment of each particular type are discussed. Current methods of individual monitoring utilize, in the main, photographic emulsions for the measurement of dose equivalents of slow neutrons, X-, β-, and γ-rays, and nuclear emulsions for the measurement of fast neutrons. However, increasing use is being made of thermoluminescent dosemeters to supplement photographic films. These methods are described and compared, and recent developments in neutron dosemeters for individual monitoring are also discussed. It is concluded that, with regard to many aspects of individual monitoring, there is little to choose between photographic film and thermoluminescent materials for the measurement of dose equivalents of slow neutrons, X-, β-, and γ-rays, but that in certain respects one method may be superior to the other. The two systems should therefore be considered as complementary rather than competitive, and one or both methods should be used, based on the monitoring requirements of each individual case. It is further concluded that a replacement for the nuclear emulsion as an individual neutron dosemeter is required because of the technical limitations of this method, the most important of which is its inability to record neutrons in the energy range thermal to about 0.5 MeV, and because it is not only expensive but dose evaluation is both time consuming and tedious. However, as yet, no satisfactory alternative has been developed. (auth) (UK)

50178 PERSONAL FAST NEUTRON DOSIMETRY AROUND NIMROD. Hack, R. C. (Rutherford Lab., Chilton, Eng.). pp 91-102 of Proceedings of the Conference on Radiation Protection in Accelerator Environments, Chilton, England, March 1969. Stevenson, G. R. (ed.). Chilton, Eng., Rutherford Laboratory, 1969.

See CONF-690320.

The response of the standard method of personal fast neutron dosimetry (Kodak fast neutron film type B) was compared with a two-element activation technique for various locations around the Nimrod experimental areas. Assuming the validity of the latter technique, the accuracy of the films is not acceptable for health physics purposes, although they seldom seriously underestimate the true dose. An empirical solution to the problem, using the film in conjunction with a thermal neutron detector (^{6}LiF), is described. (auth) (UK)

50179 FILM DOSIMETRY OF HIGH-ENERGY ELECTRONS. Dutreix, J.; Dutreix, A. (Gustave Roussy Inst., Villejuif, France). Ann. N. Y. Acad. Sci., 161: 33-43(July 3, 1969).

From Conference on High Energy Radiation Therapy Dosimetry, New York. See CONF-670665.

The basis of film dosimetry is discussed and some of its technical problems are presented. Examples are given showing its usefulness in some clinical and experimental investigations. (B.G.D.)

50180 COMPARISON OF CALORIMETRIC AND OTHER METHODS FOR THE DETERMINATION OF ABSORBED DOSE. Pinkerton, Arthur P. (Sloan-Kettering Inst. for Cancer Research, New York). Contract AT(30-1)-3510. Ann. N. Y. Acad. Sci., 161: 63-76(July 3, 1969).

From Conference on High Energy Radiation Therapy Dosimetry New York. See CONF-670665.

A quasi-adiabatic local absorbed-dose calorimeter developed and in operation at the Sloan-Kettering Institute is described. The response of ionometric, chemical, thermoluminescent, and semiconductor dosimeters was compared to this calorimeter, with respect to response as a function of depth in the irradiated medium as well as for different energies of incident electrons. Measurements with cobalt-60 gamma rays were also performed. (B.G.D.)

50181 THERMOLUMINESCENT RESPONSE OF LITHIUM FLUORIDE TO HIGH-ENERGY ELECTRONS. Suntharalingam, N.; Cameron, J. R. (Univ. of Wisconsin, Madison). Ann. N. Y. Acad. Sci., 161: 77-85(July 3, 1969).

From Conference on High Energy Radiation Therapy Dosimetry, New York. See CONF-670665.

The response characteristic of lithium fluoride has been investigated for high-energy electrons up to 33 MeV. There does not appear to be any significant difference in its response compared to that of cesium-137 gamma rays. Thermoluminescent dosimetry, though not an absolute method for measuring radiation, has been shown to be adequate as a secondary standard for electron dose calibrations. It is characterized by so many practical advantages for integrating radiation that its use is likely to continue to grow. (auth)

50182 MEASUREMENT OF DOSE EQUIVALENT AROUND LOW ENERGY ACCELERATORS. Knight, A.; Marshall, T. O. (Radiological Protection Service, Belmont, Eng.). pp 53-9 of Proceedings of the Conference on Radiation Protection in Accelerator Environments, Chilton, England, March 1969. Stevenson, G. R. (ed.). Chilton, Eng., Rutherford Laboratory, 1969.

See CONF-690320.

Methods are described which are suitable for measuring the dose equivalent of neutrons of energies below 20 MeV around low energy ion accelerators. For routine surveys around such accelerators a portable version of the Andersson and Braun rem counter is used by the Radiological Protection Service. However, where more precise measurements are required, either the Andersson and Braun rem counter or a system of 3 spherical detectors is used together with a proton recoil telescope to measure the total neutron dose equivalent. The proton recoil telescope is used to correct both the rem counter and the sphere results for the fall off in response above 10 MeV. The sphere detector system consists of slow neutron detectors at the centers of polythene spheres of different diameters. The slow, intermediate and fast components of the total neutron dose equivalent are measured by 3 separate detectors, i.e., a boron trifluoride counter for slow neutrons, an A.E.R.E. 95/0054 survey probe (4.5 in. diameter polythene sphere with a LiI crystal at its center) for intermediate energy neutrons, and a FN2/3 proportional counter for fast neutrons. Some typical results are given for the various detector systems for positions outside the shielding and in the primary beam of a 14 MeV neutron generator. (auth) (UK)

50183 SCINTILLATION DOSIMETRY, AND AN APPLICATION OF IT. O'Foghludha, F. (Medical Coll. of Virginia, Richmond). Ann. N. Y. Acad. Sci., 161: 86-93(July 3, 1969).

From Conference on High Energy Radiation Therapy Dosimetry, New York. See CONF-670665.

The advantages and disadvantages of scintillation dosimetry,

particularly in intracavitary work and in dosimetry associated with high-energy radiotherapy, are discussed. The energy dependence of scintillation techniques is briefly examined. The performance of the scintillation dosimeters in low fluxes utilizing pulse techniques is described. Scintillation dosimeters were used to study percentage doses in strictly monoenergetic beams from high-energy gamma emitters. (B.G.D.)

50184 A SIMPLE CALORIMETER FOR THE CALIBRATION OF SOLID STATE DOSIMETERS. Bewley, D. K. (Hammersmith Hospital, London). Ann. N. Y. Acad. Sci., 161: 94-8 (July 3, 1969).

From Conference on High Energy Radiation Therapy Dosimetry, New York. See CONF-670665.

A simple calorimeter is described suitable for calibration of solid state dosimeters in the range 10 kRad–10 mRad with exposures lasting a few minutes or less. (auth)

50185 A SIMPLE CALORIMETER FOR 6-MeV ELECTRONS. Goodwin, Paul (Columbia-Presbyterian Medical Center, New York). Ann. N. Y. Acad. Sci., 161: 99-100(July 3, 1969).

From Conference on High Energy Radiation Therapy Dosimetry, New York. See CONF-670665.

A simple portable calorimeter for 6-MeV electrons is described. This calorimeter is shown to be of value for intercomparison purposes and for calibration of electron beams from accelerators. (B.G.D.)

50186 CHEMICAL DOSIMETRY FOR THE MEASUREMENT OF HIGH-ENERGY PHOTONS AND ELECTRONS. Shalek, Robert J.; Smith, Charles E. (Univ. of Texas, Houston). Contract AT(40-1)-2832. Ann. N. Y. Acad. Sci., 161: 44-62(July 3, 1969).

From Conference on High Energy Radiation Therapy Dosimetry, New York. See CONF-670665.

The salient features of ceric sulfate and chlorinated hydrocarbon dosimeters are briefly reviewed. The ferrous sulfate, or Fricke, dosimeter is examined in detail. (B.G.D.)

50187 PIEZOELECTRIC CHARGING DEVICE. Mukhin, Georgy Ilich; Kljukin, Leonid Petrovich; Shlykov, Nikolai Alexeevich ; Shesterikov, Boris Alexandrovich (to Sojuzny Nauncho Issledovatelsky Institut Priborostroenia). British Patent 1,159,447. July 23, 1969. Filed Aug. 29, 1967.

Reference is made to piezoelectric charging devices, such as are used for charging direct reading dosimeters. The charging device described has coaxial piezo elements having metallised surfaces and capable of withstanding a force applied along their common axis; parallel connection is provided by electrodes on the metallised surfaces, with springs contacting the collectors. The electrodes are preferentially in the form of washers disposed between metallised butts, and fitted with flat springs. A current conducting rod in the central channel provided by coaxially disposed holes in the elements and washers may serve as collector of positive charges, the body of the device serving as a collector of negative charges. The coaxial arrangement of the elements and application force along the common central axis improves the dependability of the device. Parallel connection of the elements increases the current collection surface and ensures the charging of dosimeters of over 1×10^{-9} F capacity. The arrangement also allows a decrease of overall dimensions. (UK)

50188 DOSIMETER WITH CONTROLLED ENERGY DEPENDENCE. Denisenko, O. N.; Kozlov, V. A.; Il'ichev, B. V. (Inst. of Medical Radiology, Moscow). Med. Radiol., 14: No. 9, 58-61 (Sept. 1969). (In Russian).

In connection with the fact that the dosimeter's energy dependence is determined not only by the parameters of its detector, but also by the characteristics of its recording block, it is proposed to regulate the energy dependence by acting upon its recording block. In particular, an instance when the dosimeter's detector consists of two detectors with different energy dependences is discussed. Signals from these detectors, multiplied by diverse coefficients, are added or substracted. The energy dependence of such a dosimeter depends upon the values of coefficients and changes widely. (auth)

50189 REVISED EVALUATION OF DOSE MEASUREMENTS OBTAINED BY A SIMPLE ADIABATIC CALORIMETER. Hattenbach, K.; Melkonyan, G. A.; Segler, E. Atomkernenergie, 14: 370(1969). (In German).

Dose measurements obtained under reactor radiation with an adiabatic calorimeter were corrected by considering the values obtained with the calorimeter using a pure γ radiation and the dose measurements were separated according to the type of radiation. Values were obtained which are different from those previously reported and which are in agreement with very accurate measurements. (J.S.R.)

50190 ABOUT GAMMA DOSIMETRY IN NUCLEAR REACTORS WITH N_2O DOSIMETERS. Jeltsch, E. (Kernforschungsanalge, Juelich, Ger.). Atomkernenergie, 14: 369 (1969). (In German).

A calibration curve for the correction of the thermal neutron error in N_2O dosimeters was experimentally derived. The radiation used for the calibration was a ^{60}Co source, and the N_2O was condensed in quartz ampules. (J.S.R.)

50191 SPECTROMETRY AND DOSIMETRY OF FAST NEUTRONS WITH THE AID OF ACTIVATION. Piroth, H. D. (Philipps-Univ., Marburg, Ger.). Atompraxis, 15: 257-62(July-Aug. 1969). (In German).

The possibilities of exact evaluation of neutron-activity measurements carried out with a Van de Graaff accelerator which uses the $T(d,n)^4He$ nuclear reaction to release fast neutrons with energies from 12.8 to 15.6 MeV are studied. Three different mathematical procedures are used to calculate neutron-energy distribution inside a phantom with the dimensions of a standard human torso. The result of the study demonstrates the possibility of deep-dose determination by evaluating 12 neutron-induced nuclear reactions. (auth)

50192 SEMICONDUCTOR NUCLEAR RADIATION DETECTOR. Coche, A. (Centre de Recherches Nucleaires, Strasbourg). Onde Elect., 49: 791-5(July-Aug. 1969). (In French).

After a review of the general characteristics of semiconductor counters, the main problems encountered in the applications to radiation detection and nuclear spectroscopy are examined. (auth)

50193 COMPARISON OF THE RESULTS OF PERSONNEL DOSE SURVEILLANCE WITH POCKET IONIZATION CHAMBERS AND FILM DOSIMETERS. Helm, W.; Koenig, L. A. (Kernforschungszentrum, Karlsruhe, Ger.). Atompraxis, 15: 263-4 (July-Aug. 1969). (In German).

A comparison of results obtained by dose measurements carried out with film dosimeters and pocket ionization chambers in the Karlsruhe Nuclear Research Center is presented. The systematic variations of monthly results gained by these two measuring techniques yield an average value of about 400 mrem. The annual results differ in the extreme case by 400 mrem. (auth)

50194 A SIMPLE THRESHOLD DOSIMETER FOR RADIATION STERILIZATION OF MEDICAL PRODUCTS TO BE EVALUATED BY A VISUAL OR OBJECTIVE TECHNIQUE. Huebner, K.; Stolz, W. (Technische Univ., Dresden). Isotopenpraxis, 5: 230-3 (June 1969). (In German).

A threshold dosimeter for the sterilization of medical devices by radiation is described which shows an efficaceous change of color from yellow to red for the absorbed dose of 2.5 Mrad. The system consists of polyvinyl alcohol foils, in which chloral hydrate, sodium tetraborate, and methyl orange as the indicating dye are embedded. Any other absorbed dose within the range from 0.5 to 10 Mrad may also be indicated by the change of color when the contents of chloral hydrate and sodium tetraborate are varied. The change of color is studied as a function of the kind of radiation, of the absorbed dose rate, and of the radiation energy. Storage properties, fading, and errors in determining the absorbed dose from the change of color are discussed. (tr-auth)

Radiometric Instruments

Refer also to abstract 50041.

50195 (INR-1085) MEASUREMENT OF BORON CONTENT IN GLASS BY NEUTRON ABSORPTION. Paryski, Zygmunt; Machaj, Bronislaw (Institute of Nuclear Research, Warsaw (Poland)). 1969. 34p. (In Polish). Dep. CFSTI (U. S. Sales Only).

A neutron absorption meter for measuring the boron content in glass is described. Contents of B_2O_3 up to 25% can be determined. The stability and accuracy of the meter are discussed. (auth)

50196 (ORO-3604-5) DENSITY DETERMINATIONS USING A GAMMA RADIATION ATTENUATION TECHNIQUE. Annual Report No. 3. Dillon, I. G. (Tuskegee Inst., Ala. School of Engineering). Sept. 30, 1969. Contract AT(40-1)-3604. 23p. Dep. CFSTI.

Density measurements of coexisting vapor and liquid phases of alkali metals using a gamma attenuation technique were investigated. This technique was planned to be used at temperatures up to 2500°K. The performance of the technique for cesium up to 780°C was evaluated. (J.C.W.)

50197 (ORO-3610-1) ISOTOPE DEVICE SAFETY TESTING STUDY: INDUSTRIAL GAUGES AND RADIOGRAPHY DEVICES.

(Underwriters Labs., Inc., Chicago, Ill.). July 10, 1969. Contract AT(40-1)-3610. 87p. Dep. CFSTI.

Underwriters' Laboratories, Inc. has completed a review of safety considerations concerning industrial gaging equipment and radiography devices containing radioisotopes. The investigation included studies of the construction of these devices and their installation and operation in the field. Following these studies, commercial samples of these devices, representative of equipment now in commercial use, were set up in a laboratory and subjected to a number of tests intended to evaluate features of the devices relating to their safe use and operation. Descriptions of these tests, and the results obtained, are included in this report, which is concluded with recommendations for performance tests applicable to the safety evaluation of these devices. (auth)

50198 (UCRL-71605(Rev.1)) STATISTICAL THEORY OF DESIGN FOR PLATING THICKNESS MEASUREMENTS BY RADIATION BACKSCATTER METHODS. Fox, Jerry D.; Taylor, Grover M. (California Univ., Livermore. Lawrence Radiation Lab.). July 1, 1969. 35p. (CONF-691005-3). Dep. CFSTI.

From 29th National Convention on American Society for Nondestructive Testing, Philadelphia, Pa.

The application of statistical experimental design techniques to two methods of plating thickness measurements, x ray fluorescence and beta-radiation backscatter, is discussed. The following factors are discussed: number of standards, accuracy of standards, thickness range, and accuracy of radiation measurements for both the standard and the unknown thicknesses. A least-means-squares technique is applied for fitting the calibration curves, and analytical techniques are used to study the effect of variations in the above factors on the final uncertainty in determination of the unknown thicknesses. Tabulated experimental and theoretical data are included for guidance in designing nondestructive testing programs that use these techniques. (auth)

50199 SOIL-MOISTURE ESTIMATION BY THE NEUTRON METHOD IN BRITAIN. A FURTHER REPORT. Bell, J. P.; McCulloch, J. S. G. (Hydrological Research Unit, Wallingford, Eng.). J. Hydrol., 7: 415-33(Apr. 1969).

Various considerations concerning neutron radiation transport shields were discussed. It was indicated that if a shield was to give such protection that the operator may be in close contact with its surface for all his working hours, then a heavy or very large shield was unavoidable and restricted field operation to sites accessible by vehicle. It was maintained that it is more realistic to compromise and use a smaller, lighter shield, assuming that close contact would occur only for a very small proportion of working time. An extreme view was that a completely unshielded probe could be carried in a special holder so that it would be kept at least 4 ft away from the operator, resulting in no greater exposure than that received by carrying a conventionally shielded probe close to the body. Carriage on foot over rough terrain would be facilitated and the probe could be returned after operation to a proper shield-standard kept in the vehicle or base. (BBB)

50200 METHODS AND APPARATUS FOR MEASURING NEUTRON CHARACTERISTICS OF A MATERIAL. Nelligan, William B. (to Societe de Prospection Electrique Schlumberger). British Patent 1,163,515. Sept. 10, 1969. Filed Mar. 29, 1968.

A method is described for determining the neutron characteristics of an unknown material, such as the decay time or slowing down time of thermal neutrons therein. An application is for investigating earth formations surrounding a well bore. Apparatus containing a neutron source is moved through the bore and the surrounding formations are irradiated in response to control signals; the radiation detector within the apparatus provides signals representing the neutron characteristics in the formation, and processing means are provided responsive to signals received from the detector at different times for determining the rate of change of this neutron characteristics. Variable time delay control means are provided for controlling the interval between operation of the neutron source and operation of the processing means in dependence on the rate of change of neutron characteristics. Provision is made for repeated irradiations. Various alternative methods of operation are described. Provision is also made for measuring background radiation. The variable time delay control means may include a variable frequency oscillator producing output signals for operating the neutron source. The processing means may include at least two gates for receiving signals from the detecter after selected time intervals, and ratio circuit means for determining the ratio of the signals received by the gates. (UK)

50201 MEASURING MOISTURE WITH GAMMA RADIATION. McKinney, F. E. Isotop. Radiat. Technol., 7: 29-35(Fall 1969).

The literature on applications of gamma radiation to the determination of moisture content in soil, peat, wood, ceramic materials, construction materials, meat, and textile fibers is reviewed briefly. Activities used were 1 mC to 10 curies of ^{60}Co and 5 mC to 251 mC of ^{137}Cs. (auth)

50202 ECONOMIC GAIN OF USING MASS PER UNIT AREA ISOTOPIC MEASURING DEVICES IN THE HUNGARIAN INDUSTRY. Abelovszky, L.; Goezsy, G. (State Committee for Nuclear Energy, Budapest. Univ., Budapest). Isotopenpraxis, 5: 178-81(May 1969). (In German).

One of the most important possibilities of using isotopic gages is thickness measurements on materials manufactured in a continuous technological process. The demand for continuously increasing the production rate, for automation of technological processes, and for the reliable observance of the dimensions of materials produced (sheets, bands and tapes, foils, plates) is the foundation for the application of mass per unit area (thickness) gages. (auth)

50203 FLUORESCENCE RADIATION SOURCE FOR MEASURING AREA DENSITY AND THICKNESS. Carl, W. (Frieseke and Hoepfner GmbH, Erlangen, Ger.). Kerntechnik, 11: 431-6(Aug. 1969). (In German and English).

In the series of radionuclides used for measuring area densities, there is a lack of long-lived photon emitters with energies between 15 and 40 keV. The quantum energies of the K lines of the characteristic radiation of elements with atomic numbers between 40 and 60 are in this range. A new fluorescence radiation source is described, using ^{241}Am as the exciting primary emitter, which makes it possible to obtain the required quantum energies with the aid of appropriate fluorescence targets. The results obtained with the new radiation source are discussed. (auth)

50204 APPLICATION OF THE VA-T-70 B MASS PER UNIT AREA MEASURING DEVICE FOR MASS PER UNIT AREA PROFILE DETERMINATIONS. Henker, W. (VEB Vakutronik WIB, Dresden). Isotopenpraxis, 5: 223-5(June 1969). (In German).

The measuring device described is successfully being applied in the paper industry. Mass per unit area may be measured for newsprint and cardboard in the same way as felt. From the results the material transport on to the long sieve and fouling of the felts are estimated. Adjustment of the desired value and the recording diagram of a measuring device arranged within the wet part are being revised on the basis of these data. Same as in the paper industry this measuring technique may also be used for discontinuous determination of the mass per unit area of coated materials. (auth)

Miscellaneous Instruments and Components

Refer also to abstracts 50120, 51857, and 52046.

50205 (CEA-CONF-1346) NEW MASS SPECTROMETER FOR MEASUREMENTS OF VERY SMALL ISOTOPIC DIFFERENCES BETWEEN TWO URANIUM SAMPLES. Nief, G.; Lucas, M.; Bir, R. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Jan. 27, 1969. 4p. (CONF-690523-3). Dep. CFSTI (U. S. Sales Only).

From 17th Annual Conference on Mass Spectrometry and Allied Topics, Dallas, Tex.

The design of a new mass spectrometer to measure very small isotopic differences between two UF_6 samples is described. The main features of the spectrometer include: differential pumping with ionic pumps; special ion source mounting with direct gas introduction in the ionization chamber; use of a capillary as leak; special collector device allowing to monitor the position of the beams to be measured; gas-flow inlet system giving a constant and permanent pressure in the ion source; and digitalized device for isotopic ratios recording. The analytic procedures and the performances are given. (auth)

50206 (GEPP-68) PULSE COUNT CONVERTER SYSTEM. Miotke, J. A. (General Electric Co., St. Petersburg, Fla. Neutron Devices Dept.). June 23, 1969. Contract AT(29-2)-656. 33p. Dep. CFSTI.

A pulse converter system is described that multiplies input pulses by a 4-digit factor, which is variable from 1.000 to 5.000 with resolution and accuracy of 0.001. The number of digits in the factor can be changed from four to any number between one and a limit set by clock frequency and input pulse rate. The decimal point can be changed easily to any location in the factor. In addition, the converter system performs as a pulse divider, if the factor is less than one, and it performs as a pulse adder for a

factor of one. The converter has many applications in servo and pulse control systems. (auth)

50207 (INR–1059) DELAY PULSE GENERATOR /1.10^{-6} sec - 1.10^{-2} sec/. THE CONSTRUCTION OF THE GENERATOR AND CONTROL MEASUREMENTS. Pryczek, Miroslaw (Institute of Nuclear Research, Warsaw (Poland)). 1969. 35p. (In Polish). Dep. CFSTI (U. S. Sales Only).

A description of the construction of a delay pulse generator in time range from 10^{-6} to 10^{-2} sec is presented. The described generator is used in a phantastron circuit with switched delay ranges from 1 to 10 μsec, 10 to 100 μsec, 100 to 1000 μsec, and 1 to 10 msec. Input and output of the generator are solved with regard to other electronic devices of the Capacitor Bank 150 kJ for plasma research. The control measurements give results of accuracy obtained for time delay, rise time, and amplitude of the output pulse and jitter time delayed pulses. (auth)

50208 (NP–17998) OPTICAL TRANSMISSION OF A POINT ON A RADIOLOGICAL SCREEN WITH A SYSTEM OF TWO LENS. Decamps, J. P.; Oudin, L. (Institut Franco-Allemand de Recherches de Saint-Louis (France)). Aug. 8, 1967. 27p. (In French). (ISL-T-36/67). Dep. CFSTI (U. S. Sales Only).

An optical bench can be constructed with a certain length (two meters) to protect a fragile apparatus (light receiver or image amplifier) near waves issuing from the observation zone. It is proposed to obtain with minimum light losses an image of acceptable quality. The coefficient of light transmission between image and object was calculated point by point without taking into account the effects of diffraction by the aperture contours, and aberrations and light losses in transit across the lenses. The account is followed by a listing of machine calculations. A rapid graphical method permits research to be circumscribed by the dimensions of the bench for the required data (transmission coefficient, magnification, lens opening, etc.). (tr-auth)

50209 (RAE-TR–68099) CHEAP SENSITIVE LEAK-DETECTOR. Mair, W. N.; Bramham, R. W. (Royal Aircraft Establishment, Farnborough (England)). May 1968. 19p. Dep. CFSTI (U. S. Sales Only).

The principles and use of a simple leak-detector are described. A small, liquid-nitrogen cooled, zeolite adsorption pump is used to allow helium, used as a probe gas, to reach an ionization gauge while protecting it from other gases in the vacuum system. The leak-detection sensitivity of a helium-probed ionization-gauge is thus increased by allowing the use of a more sensitive range. The potential of the detector was assessed in experiments in which the zeolite pump alone maintained a vacuum system pressure of about 1 mtorr against an air leak of 6.5×10^{-4} torr liter sec^{-1} (0.65 lusec): it was found that the pressure in a protected gauge was of order 10 μtorr and that, for at least 2 hours, the rate of pressure rise in the protected gauge was about $\frac{1}{4}$ μtorr/min. Thus zeolite-protection allows the use of an ionization gauge for leak hunting when the in-leakage is great enough to produce a pressure which is too high for normal ionization-gauge operation; and the protection is effective for a time adequate for most leak hunts. It is estimated that, on small vacuum systems, leaks of order 10^{-7} torr liter sec^{-1} (10^{-4} lusec) should be readily located using a helium probe. (auth)

50210 (SC-RR–69-495) GENERAL STUDY OF VERGE ESCAPEMENT PERFORMANCE. Shinkle, J. N. (Sandia Labs., Albuquerque, N. Mex.). Oct. 1969. 57p. Dep. CFSTI.

Various aspects of a study of verge escapements are presented. The study was made primarily in order to define performance of inertially driven verge odometers and velocimeters when these devices are subjected to dynamic environments. A set of defining differential equations is derived and solved numerically for the cases of interest. Variation in performance is determined for the case of a statically applied driving force as geometrical and inertial variations are made in the escapement. In particular, changes were made in escapement center distance, escape wheel tooth radius, verge angles, escape wheel inertia, and verge inertia. Performance of a nominal escapement being used as an odometer and as a velocimeter is also determined for ramp, exponential, and sinusoidal acceleration inputs. It is shown that these devices perform in a manner that is radically different from their performance in a benign environment. Charts are presented which can be used to make the device more useful in quasistatic environments. Charts are also presented which show the generally erratic and unpredictable performance of the verge subjected to a vibratory input. In general, it can be said that a verge escapement is not a very useful device unless it can be isolated from vibrational input driving torques. (auth)

50211 (UCRL–18667, pp 343-80) GENERAL INSTRUMENTATION AND DEVELOPMENT. (California Univ., Berkeley. Lawrence Radiation Lab.).

Topics include development of the 88-inch cyclotron, a cascade isotope separator, particle identification of the elements up to argon produced by the interaction of 5-GeV protons with uranium, slit scattering effects with 50-MeV α particles and 20-MeV protons, uniquely determined metastable ions by ion accelerator decoupling, differentially pumped vacuum probe using cryogenic and ion pumping, and a rotating vacuum seal and anode target. (W.H.K.)

50212 (UCRL–71839) MEGACHANNEL PULSE HEIGHT ANALYSIS. Niday, J. B.; Mann, L. G. (California Univ., Livermore. Lawrence Radiation Lab.). Sept. 5, 1969. 14p. (CONF-690818–5). Dep. CFSTI.

From International Conference on Radioactivity in Nuclear Spectroscopy, Nashville, Tenn.

Multi-parameter experiments with high resolution detectors require arrays of $\geq 2^{20}$ channels for adequate examination of the data. A megachannel analyzer for on-line sorting and examination of coincidence data is being developed at LRL. With this system the data will be immediately available to the experimenter for detailed examination at any time. The system consists of a dual 4096-channel ADC, a PDP-9 computer, a CRT display, and bulk storage on a fixed-heat disk and magnetic tape. Initially the disk will have 256 tracks, each holding 4096×18-bit words arranged in 128 sectors. The heads may be switched between sectors. For each coincidence event the PDP-9 will receive up to 24 bits of information (two pulse heights plus tag bits). These bits determine the disk address whose contents must be updated according to the input information. It would be possible to store ~100 events/second in a 10^6 word array by simply updating the entire array continuously in a linear fashion. However, a more efficient approach which processes only those disk sectors currently in need of updating is described. The disk address for each event is broken into information on track number, sector angle, etc., and sorted according to sector angle into a buffer which has one location for each sector. At the appropriate time the track number information in this location determines which heat is selected and the 32 words in that sector are processed. The probability of duplicate requests for the same sector will be small if the sorting is based on the least significant bits. (auth)

50213 PRECISION STAIRCASE CALIBRATOR (May 1, 1969) (Engineering Materials). (Los Alamos Scientific Lab., N. Mex.). (CAPE–1924).

2 drawings.

A linear nine-step staircase calibrator, which is used in the field for pulse calibration of a recording system is capable of +90 V to a 51 ohm load on the top step. After connecting a pulser of known amplitude to the transmitting end of a coaxial cable, the step voltages are obtained by measuring the continuously variable supply voltage. The signal path must include an oscilloscope-camera or other recording device and may include compensators. When multiple calibration voltages are recorded simultaneously, accuracy and speed are improved. The equipment has been used for recording system pulse calibration of instruments used in nuclear explosion experiments. (For details see TID-4100.) (F.S.)

50214 HEAVY CURRENT ARCING SWITCH. Murray, J. G.; Simon, E. D.; Bronner, G.; Edmonds, G. D. (to United States Atomic Energy Commission). U. S. Patent 3,475,620. Oct. 28, 1969.

An apparatus for extinguishing arcs in a breaker switch is described. An auxiliary circuit having inductance and capacitance means forms a pulsed oscillatory circuit and diverts the current around the switch for forcing the current in the switch to zero. Thus conventional breaker switches can be used for interrupting high dc voltage circuits for plasma research reactors. (AEC)

50215 IMPROVEMENTS IN OR RELATING TO IMAGE INTENSIFIERS AND THE LIKE. Manley, Brian William (to Mullard Ltd.). British Patent 1,159,347. July 23, 1969. Filed June 6, 1968.

A particle or radiation quantum detector is described which comprises a channel intensifier device (secondary-emissive electron multiplier for an electronic imaging tube) wherein the output electrode is substantially planar and is subdivided into an array of parallel electrode conductors, with each conductor connected to a separate terminal, together with an array of target conductors lying substantially in a plane parallel to that of the electrode conductors on the output side of the device. The target conductors are parallel to each other and orientated at right angles to the direction of the electrode conductors with a second set of terminals for the target conductors. The target conductors may be associated with luminescent elements to provide a two-dimensional visual display of the positions of detected particles. Means may also be provided to give a coordinate position for an event, and also for inhibiting the system if two or more events occur simultaneously at different coordinate positions. (UK)

50216 FLOAT FOR MEASURING LIQUID LEVELS. Becker, Winfried; Gatti, Giovanni (to EURATOM). British Patent 1,165,451. Oct. 1, 1969. Priority date Mar. 30, 1966, Germany.

A float for accurate measurements of liquid level is described. The mechanical parts indicating the level are connected with the bouyancy members by means of a temperature-responsive member so that in the event of temperature fluctuations there will be a relative vertical motion for compensating the temperature effect on the immersion depth of the float. The system is suitable for use in nuclear reactors. (W.H.K.)

50217 DEVELOPMENT TRENDS IN SIGNALIZATION IN NUCLEAR POWER PLANTS. PART II. Rehfeld, G. (VEB Kernkraftwerksbau, Berlin). Mes.-Steuern-Regeln, 12: 236-8 (June 1969). In German).

The article continues with a discussion of display techniques for signalization and of composite signalization systems in nuclear power plants. The state of the art in the German Democratic Republic is reviewed and general conclusions as well as further questions to be resolved are summarized on the basis of available information. Fifty seven references are included. (JPRS)

50218 DEVELOPMENT TRENDS IN SIGNALIZATION IN NUCLEAR POWER PLANTS. PART II. Rehfeld, G. (VEB Kernkraftwerksbau, Berlin). Mes. -Steuern-Regeln, 12: 207-9 (May 1969). (In German).

The article discusses signalization in nuclear power plants, its scope and application. According to the official definition, a signal is a physical quantity varying in time and coupled inseparably to at least one other quantity which contains information. In analyzing the state of the art, consideration is given here to plain signalization, to signalization of process conditions with selective systems for added safety, to signalization for testing purposes, to sequential signalization, to programmed and to computerized signalization. Typical installations are shown and the basic layout of the operation is described. (JPRS)

50219 COLD CATHODE IONIZATION GAUGE FOR MEASURING HIGH VACUUMS. Mes., Regul., Automat., 33: No. 11, 22(Nov. 1968). (In French).

The A.E.I. VH 14 gage and its VC 14 power pack combine the sturdiness of a Penning gage with low pressure performance better than that of an ionization gage. The cold cathode gage has in fact greater sensitivity, without the limitations caused by x rays. General design is the same as that of a Penning gage: a normally cold filament mounted behind a cathode. This gage offers many advantages including wide pressure range: 10^{-4} to 10^{-13} torr; degasifiable gage with magnet mounted at 450°C; very fast response time to transient pressures above or below steady state; pumping speed normally less than 0.1 litres per second; and current sensitivity: 2.5 amps per torr. The VH 14 gage is built in stainless steel with an A.E.I. clamp with flat copper joint. The circular magnet is held in place by two clips; connections are made through a multiple female socket placed at the top of the gage. The VC 14 supply pack can be panel-mounted. Stabilization is excellent and gives a high signal-to-noise ratio. The pressure range of from 10^{-4} to 10^{-13} torr, is obtained by a 10-way selector and read on a 0-10 linear scale or a logarithmic scale from 10^{-3} to 10^{-8} torr. (Sum. Articles Fr. Tech. Press)

50220 REACTOR COOLANT IMPURITY SENSOR. Billeter, T. Roger (Battelle -Northwest, Richland, Wash.). Nucl. Appl. Technol., 7: 374-82(Oct. 1969).

Microwave techniques as used for the detection and measurement of moisture in reactor coolant gases operate because of the resonant frequency change of a microwave cavity (sensor) through which the sample gas flows, due to the corresponding change in its dielectric constant. For the experimental system, a moisture detection sensitivity of 15 ppmv/μV for sample gas at STP results for 10 mW of microwave oscillator power. The minimum moisture detection level of about 2 ppmv depends upon total system noise. Gas transport time limits the speed of response, as does the time constant of the synchronous demodulator of the sample phase-lock amplifier. For thermal equilibrium conditions, the maximum instrument drift for a one-hour interval equates to an equivalent moisture concentration range of 10 ppmv. (auth)

50221 EQUIPMENT FOR INVESTIGATION OF SHORT-LIVED ACTIVITIES EXCITED BY FAST NEUTRONS FROM A NEUTRON GENERATOR. Rurarz, Edward; Chorzewski, Jacek; Kozlowski, Tadeusz; Szczepankowski, Janusz (Inst. of Nuclear Research, Swierk, Poland). Nukleonika, 14: 338-49 (1969).

A beam pulser for pulsing the deuteron beam from a neutron generator is described. The pulser produces +500 V pulses with a rise and fall time of 1 μs, and an adjustable pulse length of 10 μs to 1 h. The electronic equipment combined with the pulsed neutron generator for measuring γ-ray spectra and nuclear half-lives is presented. The equipment is used for studying nuclear states (10 μs – 1h) excited by fast neutrons from T(d,n) and D(d,n) reactions. (auth)

50222 NUMERATION OF A MASS SPECTROMETER FOR ISOTOPIC ANALYSES. Dubois, J. C. (CEN, Saclay, France). Method. Phys. Anal., 4: 324-7(Sept. 1968). (In French).

The outlined apparatus is particularly suitable for isotopic analyses by thermoionization. The information supplied by the mass spectrometer is translated into impulses by a voltage-frequency converter, and this permits it to be memorized within a 400 canal selector. A logic circuits device controls sampling. (auth)

50223 PERFECT CRYSTAL WITH TEMPERATURE GRADIENT AS A NEUTRON MONOCHROMATOR. Alefeld, B. (Technische Hochschule, Munich). Z. Phys., 228: 454-64(1969). (In German).

Energy resolution and reflectivity of a perfect CaF_2 single crystal with a temperature gradient perpendicular to the reflecting planes have been studied. The energy resolution could easily be varied between $2 \cdot 10^{-4}$ and $7.4 \cdot 10^{-3}$. Over a considerable range of the reflecting curves the reflectivity always had its highest possible value as predicted by theoretical considerations. (auth)

50224 TRANSISTORIZED ANTICOINCIDENCE CIRCUIT FOR COUNTING AT LOW BACKGROUND LEVELS. Gyoenyoer, B.; Viragh, E. (Technical Univ., Budapest). Period. Polytech. Elec. Eng., 12: 467-79(1968).

Measurement of very low activities by the use of low-background counters is considered. Detection limits and the operation and layout of the circuits are discussed. Details are given on principles of the operation of a transistorized anticoincidence unit, and are illustrated by oscilloscope photographs. By use of the described circuit, about 2 ppM background can be achieved. No mechanical or electric modification of the scaler and lead column shield connected to the circuit are required. By improving shielding, further decreases of the background could be achieved. By such shielding arrangements employing lead + cadmium + limestone in thickness of the order of meters, background rates less than 0.8 ppM can be obtained. To set up shielding of this type, however, considerable financial investment and personnel are required. With the equipment described, an activity of 3 pCi could be determined with a probability of 100%. The advantage of the instrument used, as compared with the yacuum tube type are its cheap production (10 transistors are the greatest expenditure) and the fact that it does not take up much space. Furthermore, no modifications of shield and scaler are necessary as the dimensions of the detector are small. (BBB)

50225 HIGH-VOLTAGE ELECTRON MICROSCOPY. Cosslett, V. E. (Univ. of Cambridge, Eng.). Quart. Rev. Biophys., 2: 95-133(May 1969).

Radiation damage observed in high-voltage electron microscopy is reviewed, as well as other aspects of instrumentation and technique such as penetration; the relation between contrast, transmission, and specimen thickness and between chromatic aberration and specimen thickness; ultimate resolution and high voltage; depth of focus; design and construction of high voltage microscopes; and applications of the high-voltage microscope. Protection of personnel against the x radiation produced by the high-voltage electrons is also considered. The interaction of fast electrons with matter transfers energy to it and results in a temperature rise, ionization, bond-breakage, ejection of atoms, as well as the emission of visible and uv light, x rays, and secondary electrons. The first 4 of these effects cause damage, the nature and extent of which depends on the atomic or molecular structure of the specimen, and in particular on whether it is metallic or organic in nature. In metals the main effect of the beam is the ejection of atoms from the crystal lattice, producing interstitial atoms and complementary vacancies. Radiation effects occur in organic materials to an even greater degree because bond energies between atoms in a molecule are smaller, being a few electron volts instead of the 15 to 30 eV common in metal lattices. Also, several approaches to radioprotection of the operator are described. (BBB)

50226 STANDARD INTENSITY ELECTROMAGNETIC FIELD INSTALLATION FOR CALIBRATION OF RADIATION HAZARD MONITORS FROM 400MHz TO 40GHz. Woods, D. (Univ. of Surrey, Guildford, Eng.). Non-Ioniz. Radiat., 1: 9-17(June 1969).

An installation for producing electromagnetic fields of intensities up to 20 mW cm^{-1} for calibrating field intensity monitors is described. It consists of an anechoic chamber (designed for frequencies up to 40 GHz), a transmitting aerial of known characteristics and a range of high power sources. Owing to space and cost the chamber only operates down to 1 GHz. From 600 MHz to 400 MHz the standard field is generated in an oversize waveguide terminated in a matched load. Mention is made of the different condi-

tions existing in front of a horn radiator: near-field zone; Fresnel region; Fraunhofer region. Maximum field intensities which can be generated over various circular apertures are given, together with an estimate of the limit of uncertainty in the value of the standard intensity field at different frequencies. (auth) (UK)

50227 IONIZATION GAUGES WITH REDUCED X-RAY AND ELECTRONIC DESORPTION EFFECTS. Groszkowski, J. (Technical Univ., Warsaw). Arch. Elektrotech. (Warsaw), 28: 151-70 (1969). (In French).

Effects preventing the extension of the lower limit of pressure measurement by ionization gauges, in particular the influence of x rays, are examined. A new ionization gauge has been devised, which has some resemblance to the Bayard–Alpert gauge; however, the collector is placed outside the anode and is surrounded by a screen. The advantages of the new gauge resulting from the absence of a collector inside the anode are outlined. Electrons have multiple trajectories and the electric field is more uniform, allowing a more efficient collection of ions. The presence of a grid around the collector protects it against perturbations which may arrive at the collector otherwise. The problem of electron desorption is reviewed, and an adaptation of the gauge where this problem is reduced is presented. Characteristics of the new gauge are presented, including comparative studies with and without the adaptive features, to illustrate reduction of interference by x rays. Problems of measurement when the system is exposed to very wide variations in pressure are noted. (BBB)

50228 THE INFLUENCE OF SCATTERING PHENOMENA ON THE PERFORMANCES OF A 1/r AXIALLY SYMMETRIC FIELD PRISM ELECTROMAGNETIC SEPARATOR. Ioanoviciu, D. (Inst. for Atomic Physics, Cluj). Isotopenpraxis, 5: 225-7(June 1969).

The elastic scattering in an electromagnetic separator with 1/R axially symmetric magnetic field prism is treated by consideration of three sections on the ion path. Also some observations on the charge-exchange scattering in a device of this kind are given. Two numerical examples show that 1/R prisms compare favorably with the usual homogeneous and nonhomogeneous field separators also from the point of view of scattering phenomena. (auth)

50229 A Ge(Li) COMPTON EFFECT GAMMA RAY POLARIMETER. Lee, Y. K.; Owen, G. E.; Wiggins, J. W. (John Hopkins Univ., Baltimore). Nucl. Instrum. Methods, 174: 176-8(1969).

A gamma ray detector which is sensitive to linear polarization of the gamma rays has been fabricated from a single planar Ge(Li) detector. The operation of the detector has been tested by use of the 1.36 MeV gamma ray following the reaction $^{24}Mg(p,p')^{24}Mg^*$. (auth)

50230 TIMING SYSTEM FOR NUCLEAR EXPERIMENTS. Manfred, R. (Israel Atomic Energy Commission, Yavne). Nucl. Instrum. Methods, 174: 171-2(1969).

A timing system has been constructed which can automatically actuate different instruments at time intervals and for durations which can be chosen independently to within 0.01 sec. The system replaces 8 separate timing units. (auth)

50231 A HARDWARE BOOTSTRAP LOADER FOR THE PDP-8 SERIES COMPUTERS. Morgan, G. B. (Idaho Nuclear Corp., Idaho Falls). Nucl. Instrum. Methods, 74: 165-8(1969).

A printed circuit card hardware bootstrap loader has been designed and built for use on PDP-8 series computers. (auth)

Radiation Effects on Instruments and Instrument Components

Refer also to abstracts 51766, 51777, 51780, 51781, 51784, 51785, and 51789.

50232 SOLAR PROTON RADIATION DAMAGE OF SOLAR CELLS AT SYNCHRONOUS ALTITUDES. Lanzerotti, L. J. (Bell Telephone Labs., Murray Hill, N. J.). J. Spacecraft Rockets, 6: 1086-7(Sept. 1969).

Experimental measurements of low-energy solar protons and alpha particles at the synchronous orbit are compared to solar particle observations made simultaneously in interplanetary space, and it is seen that the fluxes and spectra of these particles are similar. The proton spectra were used to establish the bulk damage effects in a 1 Ω-cm n–p solar cell. (W.H.K.)

50233 RADIATION RESISTANCE OF Al_2O_3 MOS DEVICES. Zaininger, Karl H.; Waxman, Albert S. (RCA Labs., Princeton, N. J.). IEEE (Inst. Elec. Electron. Eng.) Trans. Electron Devices, ED-16: 333-8(Apr. 1969).

Ways of increasing radioresistance in metal-oxide semiconductor (MOS) devices are considered, and results obtained with a new gate insulator, namely aluminum oxide formed by plasma anodization, are reported. One approach toward alleviating radiation effects in MOS devices is to use a material with a defect structure that does not allow predominant trapping of either holes or electrons as a gate insulator. This was achieved with plasma-grown aluminum oxide. The Al_2O_3 films are formed by first depositing Al on freshly cleaned and properly prepared Si wafers. Subsequently this Al is oxidized in an oxygen plasma and device fabrication is then completed. The devices have excellent characteristics and stability, and their fabrication is not restricted by the conditions of the ultraclean procedures necessary for SiO_2–Si devices. Exposure to 1-MeV electron bombardment at various fluence levels and bombardment-bias conditions showed that these structures possess remarkable radioresistance. Up to a fluence of 1×10^{15} e/cm^2, under positive or negative bias, no oxide charge buildup or interface state generation was detectable. Above that fluence, only small shifts were observed, indicating that an order of magnitude improvement in device hardening can be achieved by the use of this material. (BBB)

50234 CHANGE OF CARRIER LIFETIME IN RADIATION-DAMAGED SILICON SOLAR CELLS. Usami, Akira; Ishikawa, Taro (Nagoya Inst. of Tech., Japan). Electron. Commun. Jap. (Engl. Transl.), 50: 137-9(Dec. 1967).

Radiation damage to silicon solar cells was investigated on the basis of the deterioration of both p–n and n–p type cells irradiated by a γ-ray flux from ^{60}Co of 4×10^5 rad/cm^2 hr. The deterioration of factors (ratio of short-circuit currents before and after irradiation) as a function of wavelength with γ-ray flux are shown for p–n and n–p types. For one sample, the deterioration in the longer wavelength region was marked. For another, there was substantial deterioration over the whole wavelength region (500 to 1100 nm). For a third sample, the deterioration was not so large but was present in both longer and shorter wavelength regions. The p–n type showed larger deterioration than the n–p because the recombination centers (probably E centers, E_c = 0.38 eV, $\sigma = 5 \times 10^{-14}$ cm^2) introduced in n-type bulk are proportional to the boron density and therefore have larger trapping cross sections than those (for instance, C and J centers, E_v = +0.26 eV, $\sigma = 1 \times 10^{16}$ cm^2) in p-type bulk which are proportional to the phosphorus density. Since the deterioration in the shorter-wavelength region is believed to be due to that in the diffusion layer (depth x_j), these characteristics of the n–p type can be ascribed to E centers with large cross sections existing in an n diffusion layer with high impurity. This was confirmed by the values in the shorter-wavelength region being relatively large for sample 3 which had a lower impurity density in a p-type bulk. The relation between carrier life and the wavelength that gives maximum response was considered. The values of the lifetime before irradiation obtained by the method described are listed. It was seen that the deterioration of carrier life in n-type bulk is larger than that in p-type bulk and that the deterioration, i.e., the number of the recombination centers introduced, depends on the boron density in a p-type bulk. (BBB)

50235 HARDENED ELECTRONICS. Lowenhar, Herman. Space/Aeronaut., 52: 36-43(Aug. 1969).

The design of electronic circuitry and components to withstand the injurious effects of nuclear weapon blasts is reviewed. Nuclear burst environments are envisioned which result in sublethal (under 200 rem) absorbed doses of ionizing radiation but whose associated electromagnetic pulse (EMP) and neutron fluence (of about 10^{11} n/cm^2) can permanently disable unhardened electronics. Neutron damage is proportional to the square-root of the neutron energy, and each fast neutron may cause lattice defects involving hundreds of atoms. These defect clusters degrade forward-current gain by acting as recombination centers for the minority lifetimes. The most radiation-resistant devices currently produced use heavy gold doping to degrade minority lifetimes. Far less endurable than neutron damage, though more prevalent, are the effects of ionizing radiation. Ionization, the production of hole-electron pairs in a material, results from the absorption of energetic photons and fast electrons. How photons, which comprise up to 75% of the energy in a nuclear explosion, interact with matter by Compton scattering, the photoelectric effect, and pair production is explained. These processes produce hole-electron pairs that migrate to oppositely charged junctions under the influence of the applied electric field. This photocurrent in proximity to the junctions causes minority carriers to be swept across, creating an amplified secondary photocurrent due to the device's current gain. The momentary effect is saturation of the device with a high current surge and a resultant voltage transient. The most general approach to ionization hardening is use of materials that are difficult to ionize and that recover rapidly. Progress in hardening devices against neutron, ionization, and x-ray damage has been matched by design for hardening against the EMP of a nuclear burst. Development of equipment that can reproduce various radiation components of nuclear explosions and the declining cost of radiation-hardened devices are discussed. (BBB)

LIFE SCIENCES

Biochemistry, Physiology, and Molecular Biology

Refer also to abstract 49996.

50236 (UR-49-1070) BRIEF DESCRIPTION OF RESEARCH PAPERS ACCEPTED FOR PUBLICATION DURING 1968. Annual Report. Rothstein, Aser; Neuman, William F. (Rochester Univ., N. Y. Atomic Energy Project). Apr. 1, 1969. Contract W-7401-eng-49. 129p. Dep. CFSTI.

Basic Processes

Refer also to abstracts 49743—49745, 49759, 50684, 50693, and 50773.

50237 (CONF-681037-1) INVESTIGATION OF CHROME-SENSIBILITY WITH HELP OF ACTIVITY ANALYSIS IN TRACER TECHNIQUE. de Goeij, J. J. M. (Reactor Instituut Delft (Netherlands)). [1968]. 12p. (In Dutch). (RI-133-68-15). Dep.

From Conference on Nuclear Medicine, Amsterdam, Netherlands.

A clear historical development is given of the work done at the Nijmegen Veterinary Clinic and at the Reactor Institute in Delft in an attempt to understand the physiological mechanisms that cause eczema in individuals sensitized to chromium. Such individuals, once sensitized after repeated exposure to Cr^{6+} over a long period of time, develop an eczema upon renewed skin contact with extremely small doses of the element. It was thought at first that the Cr might accumulate in the skin, and that the eczema might appear after a critical level had been reached. However, activation analysis of skin samples from both normal and affected individuals showed no significant differences but, on the contrary, showed wide ranges of levels in both categories, explained as either normal biological variation or contamination, despite elaborate precautions against the latter. Serum analysis followed, dried samples undergoing activation analysis, but with results no better than before. In order to determine which organs were actually critical with regard to Cr uptake, tracer studies were undertaken with guinea pigs. Although the results differed considerably, depending upon the method of administration of $^{51}Cr^{6+}$, (i.v. or subcutaneous injection) it appeared that Cr accumulates in the red blood cells and the spleen. Two mechanisms might operate here. The Cr might diffuse through the skin, and be transported by the lymph to the erythrocyte production sites, and there incorporated into the erythrocytes, or it might be moved directly to the spleen, and from there transferred, in part, via the lymphocytes, to the erythrocytes. There is no evidence either way, as any lymph glands analyzed were taken from sites far removed from the eczema, in order to avoid contamination. It does appear, however, that the Cr levels in the erythrocytes, plasma, and spleen are lower, after i.v. injections of Cr, in Cr-sensitized animals than in normal animals. Results are presented in tabular form. (C.O.)

50238 (COO-1758-16) EFFECT OF GRADED LEVELS OF PARATHYROID EXTRACT AND CALCIFEROL UPON THYROID HORMONE SECRETION RATE (TSR) IN NORMAL FEMALE RATS. Singh, D. V.; Turner, C. W. (Missouri Univ., Columbia. Dept. of Dairy Husbandry). [nd]. Contract AT(11-1)-1758. 8p. Dep. CFSTI.

The effect of graded doses of parathyroid extract (PTE) and calciferol upon thyroxine secretion rate (TSR) of normal female rats was studied with the aid of ^{131}I. Administration of 20, 30, and 40 U.S.P. units of PTE/100 g. b.w./day for 14 days induced a significant ($P < 0.025$) increase in TSR of 25.4, 35.6, and 54.1%, respectively, over their own controls associated with slight increase in body weight. Administration of calciferol (Vit. D_3) in doses of 0.1, 0.15, and 0.2 mg/100 g. b.w. induced a nonsignificant reduction in TSR of the first two groups (groups IV and V) but a significant 26.7% ($P < 0.05$) increase in TSR above their own control in group VI associated with loss of body weight of 14.2% when 0.2 mg calciferol/100 g. b.w. was given daily for the same period. A nonsignificant increase in weight of ovaries and uteri and a decrease of thymus glands with significant increase in thyroid and adrenal weights was noticed in the group treated with 0.2 mg calciferol/100 g.b.w. as compared to 0.1 mg calciferol/100 g.b.w. (auth)

50239 EXPERIMENTAL STUDY OF PERIPHERAL CIRCULATION AND BONE GROWTH. SURFACE COUNTING OF A BLOOD-BORNE RADIOACTIVE EMITTER. Ray, Robert D.; Aouad, Ramez; Kawabata, Mayasa (Univ. of Illinois, Chicago). Contract AT (11-1)-507. Clin. Orthop. Related Res., No. 52: 221-32(May-June 1967).

Use of various isotopes was considered and a new method was developed for assessing peripheral blood flow and volume and to evaluate the changes induced in the peripheral circulation by arteriovenous fistulae, fractures, and immobilization. Radioiodine (^{131}I)-tagged serum albumin (RISA) was used because the isotope remains in the vascular system an appreciable length of time (the average loss at 10 min ranging from 1.0 to 3.0% of the injected dose). From 100 to 200 μCi was injected into the ear veins of rabbits and into the antecubical veins of dogs. A collimated 2-in NaI scintillation detector was placed over each hind limb at a distance of 25 cm. Each leg was passed through a small opening in a 8 × 8 in., 2-cm-thick lead shield to exclude the body of the animal from the detectors; and another lead shield was placed between the legs, thus isolating the two extremities. One-min counts then were recorded for the next 15 min, and a blood sample was taken. The legs were frozen, and the skin muscle and bone were dissected separately. The number of cpm/g wet weight of tissue was determined and the results expressed as a ratio of experimental to normal. Creation of femoral arteriovenous fistulae in puppies was followed by an increase in the rate of blood flow and in the blood volume of the limb, as measured by surface-counting technics; these changes coincided with an increase in bone growth both in length and width. Following a surgically created fracture of the tibia in rabbits, there was an increase in blood volume but not in rate of flow. The increase in blood volume reached a maximum 4 weeks after fracture, and it was not due to cast immobilization. The method of surface counting, using a blood-bound radioisotope, permitted general evaluation of the circulatory dynamics of an extremity as seen by the detector. (BBB)

50240 ROLE OF THE RADIOISOTOPES IN THE STUDY OF THE MECHANISMS OF PROTEIN BIOSYNTHESIS. Kruh, J. (CNRS, Paris). Ann. Biol. Clin. (Paris), 26: 583-97(May-June 1968). (In French).

The rapid development of molecular biology during the past few years results in part from the use of tracer methods employing ^{14}C or tritium. Using these methods, proteins, nucleic acids, and intemediaries of their biosynthesis in animals that are present in the cell in only small quantities, but which possess important biological and metabolic properties, can be characterized. The following fundamental discoveries were based on work using isotopes: the mechanism of protein biosynthesis at the sub-cellular level; the discovery of messenger RNA's, the metabolism, and mode of action; the partial structure of nucleic acids particularly the messenger RNA's; the genetic regulation of protein biosynthesis, and recently evidence for the existence of repressor; and the complete determination of the genetic code. (auth)

50241 SIMPLIFICATION OF DETERMINATION OF SERUM THYROXINE IODINE BY COMPETITIVE BINDING ANALYSIS. Nusynowitz, Martin L.; Waliszewski, Jerome (William Beaumont General Hospital, El Paso, Tex.). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 106: 791-3(Aug. 1969).

The method for the determination of serum thyroxine iodine by competitive binding analysis (T_4CBI) was greatly simplified. The results are identical to those obtained by using standard methods; correlation with thyroxine iodine by column chromatography is high, and there is no significant difference when compared to protein bound iodine in normals. (auth)

50242 RADIOIMMUNOASSAY FOR BOVINE LUTEINIZING HORMONE (BLH). Chung, Pin-kwen. Knoxville, Tenn., Univ. of Tennessee, 1968. 54p.

Thesis.

Recent progress in immunological techniques has revealed the possibility for more sensitive methods for assaying protein hormones. A radioimmunoassay technique was developed for the detection and direct measurement of physiological levels of human pituitary luteinizing hormone in blood plasma. The radioimmunoassay is based on the competition between ^{131}I-labeled hormone and unlabeled hormone for antibodies to the hormone. The separation of free hormone from antibody-bound hormone is achieved by precipitation using antibody to γ-globulin of an animal in which the antihormonal serum was produced. This study was initiated to develop the radioimmunoassay technique that could be used to measure physiological levels of bovine LH directly from

blood without concentration or purification. The assay was used to measure the variation of luteinizing hormone in the blood of four cows during the estrual cycle. The average levels of the hormone was less than 1.5 mμg equivalents of the standard (NIH-LH-B5) per ml of serum during diestrus but increased 10 to 20 fold during estrus. The concentration of the hormone in the blood increased sharply in the early stages of estrus and decreased rapidly in the late stage of estrus. The results indicated that the procedures can be used to measure the luteinizing hormone activity in 1 ml of blood. (Disser. Abstr.)

50243 A SIMPLE, RELIABLE METHOD OF MEASURING GLOMERULAR FILTRATION RATE USING SINGLE LOW DOSE SODIUM IOTHALAMATE-^{131}I. Cohen, Melvin L.; Smith, Fred G. Jr.; Mindell, Robert S.; Vernier, Robert L. (Univ. of California, Los Angeles). Pediatrics, 43: 407-15(Mar. 1969).

A radioisotope method for measuring glomerular filtration rate (GFR) in children was developed that permitted reduced radiation doses. These doses were measured. The renal clearances of sodium iothalamate-^{131}I after a single intravenous dose of 10 μCi were compared with inulin clearances and endogenous creatinine clearances. In 40 comparative studies made between the isotope and inulin clearances, correlation was excellent (r = 0.995), suggesting that sodium iothalamate-^{131}I clearance accurately measures GFR. Ten μCi of sodium iothalamate-^{131}I was injected intravenously. After a 30- to 60-min equilibration period, the bladder was emptied by voiding and a blood specimen obtained. A timed, voided urine was then collected and again a blood specimen obtained at the time of voiding. Both blood specimens and the urine were counted in a well-type scintillation counter with γ spectrometer. Most isotope investigations utilized either continuous infusion or moderately high doses to measure renal function. The present results suggested that 5 μCi of iothalamate ^{131}I, as a single dose was as efficient as 10 μCi, so that the lower dose may give equivalent results. Radioactivity given the patient with either dose was minimal when compared to the much larger doses of isotopes for other diagnostic and therapeutic procedures. The measurable radioactivity in the blood diminished rapidly within 3 hr and equalled background activity by 5 to 6 hr. The whole-body radiation dose in a 30-Kg child who was anuric was ~37 mrad and the dose in the same child with a normal GFR was 0.25 mrad. The kidney and bladder radiation dose with a normal GFR was 1.25 mrad and 3.2 mrad, respectively. The radiation dose delivered to skin with a standard chest x-ray is ~10 mrad. This study is the first to utilize a single, low-dose injection to minimize the radiation hazard. Radiation doses received in other techniques are compared. (BBB)

50244 SOME ENVIRONMENTAL FACTORS INFLUENCING THE IN VITRO PHAGOCYTOSIS OF INERT TEST PARTICLES. Metzger, George V. Rochester, N. Y., Univ. of Rochester, 1968. 166p.

Thesis.

This study directs itself towards the goal of a greater understanding of the effects and interactions of a variety of environmental factors on the in vitro phagocytosis of inert test particles. Mononuclear cells derived from either rat peritoneum or lung were used as phagocytes, and the test particles consisted of heavy metal oxides and carbon. Removal of calcium and magnesium ions from a balanced-salt medium was shown to decrease the amount of phagocytosis, as measured by the percentage of cells participating and the mean number of ingested particles per cell. The effects of added calcium or magnesium ions to a simple saline medium were then measured. Calcium ions, in appropriate concentration, were found to enhance the phagocytosis of the metal oxides but not carbon; added magnesium ions were without effect. Time-course experiments showed that the calcium ion-enhanced phagocytosis was due to an increase in the rate of phagocytosis. The effects of other multivalent cations on phagocytosis were studied when added to a saline medium. Uranyl (UO_2^{2+}) and thorium (Th^{4+}) ions were both found to bring about significant enhancement of phagocytosis of the metal oxides but not carbon. For a given cell concentration the relative concentrations of cations needed to bring about significant enhancement of phagocytosis over that obtained in the saline controls were found to occur in the descending order $[Th^{4+}] < [UO_2^{2+}] < [Ca^{2+}]$. (Disser. Abstr.)

50245 ASYMPTOMATIC PRODUCTION OF ACTH: RADIO IMMUNOASSAY IN SQUAMOUS CELL, OAT CELL, AND ADENOCARCINOMA OF THE LUNG. Hauger-Klevene, Julia H. (Univ. of Texas, Houston). Cancer, 22: 1262-7(Dec. 1968).

Twenty-six patients with carcinoma of the lung and normal electrolytes were studied. The most significant findings were: elevated plasma ACTH, lack of diurnal rhythm, and failure of dexamethasone to suppress plasma ACTH in eight patients. Two patients had oat-cell carcinoma, three had squamous cell carcinoma, and three had adenocarcinoma of the lung. ACTH-like material was found in the tumor tissue of one patient with squamous cell carcinoma. Plasma corticoids were elevated in 76% of the patients due to the effect of severe disease on the pituitary-adrenal axis and increased binding of plasma corticoids to plasma proteins. It is suggested that increased production of estrogen from the adrenal cortex may play an important role in the binding of cortisol to plasma protein. Plasma ACTH is the most reliable index in diagnosing "non-endocrine" Cushing's syndrome; it is an effective indicator of response to treatment or in determining the emergence of functioning metastasis. (auth)

50246 VALIDATION OF A METHOD FOR BLOOD FLOW IN ADIPOSE TISSUE OF RATS BY CLEARANCE OF ^{86}Rb. Mayerle, Joan A.; Havel, Richard J. (Univ. of California, San Francisco). J. Appl. Physiol., 26: 513-16(Apr. 1969).

Clearance of ^{86}Rb after intravenous pulse injection, used to measure blood flow in adipose tissue, was evaluated. Criteria used to test validity were: (1) stability of ^{86}Rb content in adipose tissues at stated intervals after injection of isotope; (2) similarity of flow estimated simultaneously from clearance of ^{86}Rb in epididymal fat and from collection of blood from the spermatic vein; (3) similarity of fractional extraction of ^{86}Rb in adipose and non-adipose tissues. The ^{86}Rb was measured in rat tissues obtained 60 sec after intravenous pulse injection and cardiac output was estimated from dilution of isotope in blood collected from an aortic catheter. The observations indicated that flows estimated from product of fractional clearance of ^{86}Rb and cardiac output are valid. Content of ^{86}Rb in epididymal, mesenteric, retroperitoneal, and intrascapular fat was stable 30 to 60 sec after injection, but lower after 90 sec. Flow measured from the spermatic vein of large, castrated rats agreed closely with values obtained simultaneously by the clearance method. Mean values and standard errors for 10 rats (ml/min × g wet weight) were 0.057 ± 0.014 from clearance of ^{86}Rb and 0.053 ± 0.013 for directly measured flow. Fractional extraction during constant infusion of ^{86}Rb was 0.79 for epididymal fat and 0.80 for the region drained by inferior vena cava. (BBB)

50247 EXPERIENCE WITH THE PREPARATION AND USE OF ^{99m}Tc SULFIDE COLLOID. Szymendera, J.; Malinowski, A. Z.; Chequillaume, J.; Tolwinski, J. (Inst. of Oncology, Warsaw. Centre Paul Papin, Angers, France). Nucl.-Med., 7: 388-95 (Dec. 31, 1968).

A simplified method of preparing ^{99m}Tc-sulfide colloid for visualizing the reticuloendothelial system is described. The most frequent untoward reactions due to colloidal-stabilizers and the protection of personnel against undue radiation exposure while preparing and administering the scanning colloid are discussed. Of the two widely used methods of preparation adapted and examined, the most convenient procedures produced untoward reactions: a pyrogenic reaction while using gelatin, and a histamine-type reaction while using dextran as stabilizers. A modified method using polyvinylpyrrolidone as stabilizer, an apyrogenic and non-antigenic substance, was suggested. (auth)

50248 ^{18}F COMPLEXES FOR BONE SCINTIGRAPHY. Maier-Borst, W.; Sinn, H. (Kerbsforschungszentrum, Heidelberg). Nucl.-Med., 7: 396-401(Dec. 31, 1968). (In German).

An apparatus constructed from Teflon was used to avoid the formation of $(SiF_6)^{2-}$ during the separation of ^{18}F from Li_2CO_3. Experiments on animals showed that the incorporation of pure ^{18}F ions into bone is slower than that of $(Fe^{18}F_6)^{3-}$ or $(Al^{18}F_6)^{3-}$. Since after double-labeling of the complex with ^{18}F and ^{59}Fe the rates of incorporation of the two radioisotopes appear to be similar, it may be assumed that the complex is taken up by bone in toto. The use of the $(Al^{18}F_6)^{3-}$ complex for scanning was studied and useful diagnostic results were obtained. (auth)

50249 ULLBERG TECHNIQUE OF WHOLE-BODY AUTORADIOGRAPHY. Waddell, William J.; Brinkhous, William K. (Univ. of North Carolina, Chapel Hill). J. Biol. Photogr. Ass., 35: 147-54(Nov. 1967).

Details are given of a technique used to determine the distribution of tritium, ^{14}C, ^{35}S, and ^{125}I in whole mice. A thin slice through the entire length of the frozen animal was cut onto cellophane tape. The tape furnished a stable backing and prevented the thin, fragile section from crumbling. Another detail is that of preserving the location of the compound in the body by rapidly freezing the animal, and not allowing either thawing or any liquids to come in contact with the tissues until after the autoradiogram is made. The specific, physiological isotope-binding sites were accurately located by this technique. Any technique that allowed thawing of the animal or permitted any solvent to come in contact with the tissue section would have either translocated or removed the compound. (BBB)

50250 ELECTROPHORETIC INDEX: A PARAMETER OF THYROID FUNCTION. Taylor, Kathleen; Winikoff, Dora (Alfred Hospital, Melbourne). Australas. Ann. Med., 17: 49-55 (Feb. 1968).

A method employing ^{131}I or ^{125}I labeled thyroxine, and determination of the capacity of serum thyroxine-binding globulin and albumin to bind added radiothyroxine in vitro was utilized as a diagnostic test of thyroid function. After electrophoresis on cellulose acetate, the ratio of radioactivity in the α_1- to α_2-globulin zone to the total radioactivity present in the protein area, expressed as a percentage, is termed the electrophoretic index (EI). The normal range of values lies between 61% and 75% (mean 68.9 ± 3.86). The hyperthyroid range is below the lower limit (mean, 54.9 ± 6.03), while the hypothyroid values are above the upper limit (mean, 79.8 ± 2.90). The clinical conditions under which the EI is most contributory to correct diagnosis, in the presence of conflicting protein-bound iodine and resin uptake results, include treated thyroid disease and suspected thyroid disfunction in which there is a high blood level of iodine as a result of laboratory contamination, the use of x-ray media or the intake of iodine preparations. (BBB)

50251 UPTAKE OF TRITIATED THYMIDINE BY CANCER CELLS IN BLOOD. Kuper, S. W. A.; Sellwood, R. A. (Royal Postgraduate Medical School, London). Brit. J. Surg., 56: 203-4(Mar. 1969).

A new radioisotope method was devised for detection of circulating cancer cells, and was used to demonstrate such cells in patients undergoing radical surgery for carcinoma of the bronchus. Tritiated thymidine (1.5 μCi/p ml) was added to 5 ml blood samples together with a pinch of carbonyl-iron powder. Samples were incubated for 3 hr to allow uptake of thymidine by those cells that were synthesizing DNA. Red cells were then lysed with saponin, and polymorphs removed with a magnet. After fixation in 10% formalin and 10% acetic acid in 50% alcohol, the cell suspension was drawn gently through a Millipore membrane filter, with pores 5 μ in dia. The membrane was then coated with photographic emulsion and dried. After 14 days the membrane was treated with developer, washed, and fixed. It was then stained with hematoxylin and eosin and mounted. Of the 85 samples studied, 14 (16%) contained clumps of cells with malignant characteristics. Autoradiographs were examined for labeled cells. Many samples contained clumps of cells so large that the number of cells could not be counted accurately. Some circulating cancer cells were alive and dividing actively. Presumably they may be regarded as potential metastases. (BBB)

50252 SIMPLE METHOD FOR DETERMINATION OF ABSOLUTE "SPECIFIC ACTIVITY" IN INDIVIDUAL CELLS. Ritzen, M. (Karolinska Institutet, Stockholm). Acta Histochem., Suppl. No. 8, 275-8(1968).

Several methods can be used for estimating the absolute amount of radioactivity present in a cell, as measured by autoradiographic methods and theoretical calculations and empirical comparisons with a known reference source. However, the theoretical approach does not consider variations in the photographic processing, sensitivity of the emulsion, and other factors, and no empirical method is simple enough to permit the use of a known reference source in all autoradiographic experiments with quantitative aims. A simple method was developed during a study of the uptake of tritiated 5-hydroxytryptamine (5-HT) and 5-hydroxytryptophan in vitro by rat mast cells. A known reference ^3H source was used to make it possible to compare different experiments with each other, and to determine the total capacity of the mast cells to concentrate these substances from the medium. All β-particles emitted from tritium are absorbed by a 3 to 4 μm thick layer of methacrylate. Thus, provided sections exceed this thickness, the number of emergent β-particles will be constant over a certain area, for a fixed concentration of radioactivity. Good proportionality was found between grain density and radioactivity of the methacrylate. The same requirements on infinite thickness for the reference sections must also be met by the cells investigated. A mass thickness of 0.05 mg/cm^2 absorbs 90% of ^3H β-particles. There is no difficulty in exceeding this limit with sections, but care must be taken when studying spread cells. Thus, knowing that both the reference plastic sections and the cells are of infinite thickness with respect to β emission, the grain density of the two can be directly compared. In this way, the concentration of radioactivity in the cell is determined. This proved to be of value for investigation of 5-HT uptake in mast cells. (BBB)

50253 RADIOIMMUNOASSAY FOR RAT PROLACTIN. Niswender, G. D.; Chen, C. L.; Midgley, A. R. Jr.; Meites, J.; Ellis, S. (Univ. of Michigan, Ann Arbor. Michigan State Univ., East Lansing. Ames Research Center, Moffett Field, Calif.). Proc. Soc. Exp. Biol. Med., 130: 793-7(Mar. 1969).

A double antibody radioimmunoassay method for prolactin was developed and tested in rats. The method uses the reaction between antirat prolactin and ^{131}I-prolactin and is capable of measuring prolactin in as little as 100 μl of serum. Data are included on the prolactin content of serum from rats during different endocrine states. (C.H.)

50254 STUDIES OF THE ELECTROLYTES CONTENT IN MAN WITH THE AID OF WHOLE BODY COUNTERS. Kunkel, R. E.; Oberhausen, E.; Muth, H. (Univ. der Saarlandes, Homburg, Ger.). Kerntechnik, 11: 322-7(June 1969). (In German and English).

The exchangeable sodium and potassium in man can easily be determined by the isotope dilution method using a whole-body counter. With ^{82}Br- and ^{51}Cr-EDTA it is further possible to estimate distribution volumes that are identical with the insulin-space representing the extracellular fluid within the experimental error. (auth)

50255 MIGRATION STREAMS OF HAEMATOPOIETIC STEM CELLS. Barnes, D. W. H.; Loutit, J. F. (Medical Research Council, Harwell, Eng.). Haematol. Lat. (Milan), 10: 3-11(Jan.-Mar. 1967).

Stem cells circulate in the blood stream not only in embryonic life when other migrations are taking place, but throughout life. Their demonstration in blood is by the formation of spleen colonies following transfer to heavily irradiated mice. The source of stem cells is in myeloid tissue and this includes red bone marrow, fetal liver and, in the mouse, spleen. This was repeatedly confirmed in experiments in mice involving radiation chimeras. From the transfer experiments it was concluded that bone marrow is the source of stem cells not only for marrow itself but also for lymph nodes and thymus. In the absence of a major need for bone marrow it would appear that the exchange of stem cells between marrow sites was not extensive. The experiment with partial body irradiation showed that the replenishment rate for both lymph node and thymus is considerable. Usually lymph node cells, although capable of limited self-replication, are not a self-maintaining population and require replenishment from myeloid sources. The thymus is supplied from these myeloid sources. In the radiation chimera experiments where retransplantation was performed lymph node cells homed to lymph node at an early stage; thymus cells acquired homing properties more slowly than lymph node and homed to lymph node. Thymus, in its natural site or after grafting, heterotopically imports cells from myeloid sources but not from lymph nodes. This was shown in the natural situation of synchorial chimerism, and was suggested by the parabiosis and part-body irradiation experiments. After grafting thymus loses its cells to spleen and lymph nodes and replenishes from myeloid sources. It is still not proven that in its natural site the thymus exports cells. The experiments with thymectomy of one partner of a parabiotic pair suggests this. The effect of thymectomy in radiation chimeras shows that the thymus is not essential for recovery provided that sufficient lymphocytes are present in the restorative inoculum. (auth)

50256 A FAST PROCEDURE FOR RADIOIMMUNOASSAY OF H. G. H. Pennisi, F. (Univ. of Pisa, Italy). J. Nucl. Biol. Med., 12: 137-8(July-Sept. 1968).

The double antibody technique at 37°C developed and employed for human growth hormone (HGH) radioimmunoassay in plasma or serum is described and discussed. The mean concentration of HGH in 120 normal subjects was 2.16 ng/ml; this value is in substantial agreement with that obtained with previous technique. (auth)

50257 ^{131}I-HYPAQUE AND ^{140}La-DTPA FOR THE MEASUREMENT OF GLOMERULAR FILTRATION RATE IN DOG. Bianchi, C. (Albert Einstein Coll. of Medicine, New York); Blaufox, M. Donald. J. Nucl. Biol. Med., 12: 117-20(July-Sept. 1968).

The mechanism of renal elimination of two glomerular tracers, ^{131}I-hypaque and ^{140}La-DTPA, was evaluated in dogs. Different urine flow rates and tubular blockade with probenecid did not produce any remarkable variation of their renal clearance. A significant difference between the clearances of the two tracers was observed. (auth)

50258 MEASUREMENT OF PLASMA VOLUME USING ^{99m}Tc, AND ^{113m}In LABELLED PROTEINS. Hosain, Parvathi; Hosain, Frazle; Iqbal, Quazi M.; Carulli, Nicola; Wagner, Henry N. (Johns Hopkins Medical Institutions, Baltimore). Brit. J. Radiol., 42: 627-30(Aug. 1969).

The short-lived ^{132}I-labeled serum albumin (HSA) was previously used for the repeated estimations of blood volume with reduced dose of radiation. The possibilities of using ^{99m}Tc-HSA and ^{113m}In-chloride (the short-lived blood-pool scanning agents) for similar measurements were explored. Simultaneous measurements of plasma volume were carried out in human subjects using ^{99m}Tc-

HSA or ^{113m}In-chloride with ^{131}I-HSA. The values obtained with the new agents were comparatively higher (about 5%) than results with ^{131}I-HSA. Studies in dogs showed that a direct slow injection of $^{113m}InCl_3$ in acidic saline could be used for the measurement of plasma volume, though pre-labeling of plasma transferrin by simple mixing improved the accuracy. The method was applied in repeated estimations of blood volume within a few hrs in normal women and to determine changes in blood volume after delivery in pregnant women. The relative values of whole-body radiation doses per estimation of plasma volume were calculated and found to be 0.16, 0.19, 0.28, 0.45, 2.30, 13.68, and 19.22 mrads respectively for proteins labeled with ^{99m}Tc, ^{113m}In, ^{123}I, ^{132}I, ^{125}I, ^{131}I, and ^{51}Cr. (auth)

50259 RADIOACTIVELY LABELED AEROSOLS. Shapiro, J. (Harvard Univ., Cambridge, Mass.). Atmos. Environ., 3: 237(Mar. 1969).

The author discusses the paper under this title by K. R. Spurny in Atmospheric Environment 2: 429-40(1968). In connection with studies using as tracers the decay products of radon and thoron a warning is issued that it must be ensured that the daughter products do not become detached from the aerosol in significant quantities during experimental work. In air the loss of deposited daughter activity from recoil after alpha decay of the parent atoms could also be a problem. Although the use of ^{14}C and T is discouraged because of their soft radiations, it is pointed out that these radiations can readily be measured using liquid scintillation counters, and that these isotopes may have many applications in this field; they have the advantages of very low handling hazard and simplicity of control. Although the use of activation analysis in this field is also discouraged, it is pointed out that it is a useful method. Activation can be used to analyze the particles after completion of experiments, and the dispersion of initially radioactive particles is avoided. A reply is made by Spurny, who states that the use of radioactive tracer techniques in aerosol studies could be dangerous, although not so under good safety conditions in laboratories. The loss of daughter activity by recoil in air should be considered in long term experiments. Spurny also comments on the use of ^{14}C, T, and activation analysis. (UK)

50260 INVESTIGATION OF THE EFFECT OF DATA ERROR IN THE ANALYSIS OF BIOLOGICAL TRACER DATA FROM THREE COMPARTMENT SYSTEMS. Myhill, J. (Univ. of Sydney). J. Theor. Biol., 23: 218-31(May 1969).

How errors in data, obtained from radioisotope tracer studies employing serial measurements of radioactivity, affect mathematical analysis of the results is examined. Computer simulation was used to produce data with error of different magnitude and form for each of several values of rate constant and amplitude. The data were terminated when the value of the last point was 1% of the value of the first point, and in other ways arranged in an attempt to simulate experimental situations. The sets of simulated data for a 3-compartment system were analyzed by nonlinear least squares. The error in derived parameters was defined by these numerical experiments in terms of the magnitude of error in data, statistical distribution of error in data, the number and spacing of the data points, and the ratios of the rate constants and amplitudes. The results can be used to help decide what experimental accuracy is needed for a given accuracy of model parameters for various biological problems. (BBB)

50261 STATISTICAL EVALUATION OF REACTION MECHANISMS IN IMMUNE HEMOLYSIS. II. THE KINETICS OF RELEASE OF ^{86}Rb AND HEMOGLOBIN FROM ERYTHROCYTES DAMAGED BY ANTIBODY AND COMPLEMENT. Hoffmann, Louis G. (Univ. of Iowa, Iowa City). Immunochemistry, 6: 309-25(Mar. 1969).

A model was developed to account for the kinetics of the release of ^{86}Rb from red cells and was applied to data for $^{86}Rb^+$ and hemoglobin release by sheep erythrocytes with varying numbers of lesions caused by antibody and complement. The results were analyzed by nonlinear least squares regression. The results support the model, that postulates that each lesion contributes equally and independently to the rate of $^{86}Rb^+$ and hemoglobin release. An estimate of the average number of lesions per cell may therefore be obtained from this rate. The results also show that measurements of $^{86}Rb^+$ release are less precise than spectrophotometric determinations of hemoglobin release. A new treatment of control data for hemolytic experiments, based on the kinetics of lysis of cells not exposed to complements, is proposed. (BBB)

50262 ADVANCES IN THE USE OF NEUTRON ACTIVATION ANALYSIS IN BIOLOGY AND MEDICINE (1962-1967). Rakovic, M. (Karlova Univ., Prague). Cas. Lek. Cesk., 108: 43-51(1969). (In Czech).

One hundred and eighty-two quotations from the literature are given and advances in the activation analysis of biological material during recent years are discussed. Interest in this method in biology, medicine and allied disciplines in the world is not declining, but steadily increasing. In addition to methodical work the number of publications is increasing where by in this method not only problems of medical research but also of clinical practice are solved. The development of activation analysis in coming years will, no doubt, expand rapidly due to the development of new equipment. Thus e.g., instead of hitherto used scintillation gamma spectrometry the use of semiconducting detectors will expand which will make possible a better differentiation and thus the estimation of many elements in biological material without chemical isolation. (auth)

50263 STUDY OF THE BINDING OF COLLOIDAL PARTICLES OF ^{198}Au WITH SERUM PROTEINS IN HEALTHY SUBJECTS. Cohen, Yves; Rousselet, Jean-Pierre (CEN, Saclay, France). Ann. Pharm. Franc., 27: 115-27(Feb. 1969). (In French).

It was demonstrated that ^{198}Au in blood is bound to serum proteins. Methods are described for gel filtration of serum proteins and demonstration of radiogold by sedimentation autoradiography. These methods were applied to serum proteins of man, rabbit, guinea pig, and rat. Physical and chemical characteristics of several different preparations of radiogold are given. Their specific activity varied from 0.02 to 4.55 μCi/μg. After addition of ^{198}Au to blood in vitro or in vivo, centrifugation gave three fractions containing radioactivity: red cells, leukocytes, and plasma. The radioactivity in plasma was either free or bound to protein. Electrophoretic studies showed that the bound ^{198}Au migrated with the serum α-globulins, the largest colloidal ^{198}Au particles with the α_2-globulins and the smaller one with α_1-globulins. All four animal species gave the same result. (BBB)

50264 IS THE SPECTRAL ABSORPTION OF INDOCYANINE GREEN ALTERED BY RADIATION. Davis, Lawrence W.; Brown, James A.; Strike, Thomas A. (Armed Forces Radiobiology Research Inst., Bethesda, Md.). Amer. Heart J., 78: 140-1(July 1969).

Whether a tracer dye used in cardiovascular function studies is affected by ionizing radiation, and thus affects results in irradiated subjects, was evaluated on the basis of the absorption characteristics of indocyanine green. Furthermore, since neutrons activate blood sodium and the dye injected into an animal irradiated with neutrons is subjected to an environment of radiosodium, neutron irradiation was used. Blood and dye solution were exposed to various mixed γ-neutron reactor radiation doses (0.53 to 48 Krad). In a second experiment, blood was obtained from 2 dogs 1.5 hr following irradiation. One dog received 5000 and the other 10,000-rad whole-body doses of mixed γ-neutron radiation. Blood was diluted, unirradiated indocyanine green added, and absorption of the samples measured over the range of 700 to 850 nm. The absorption peak of the control absorption spectrum (unirradiated blood and dye) occurred at 803 nm. The spectra of all the irradiated samples from both experiments had absorption peaks identical to the controls, and the heights of the peaks were not significantly different from those of the control. These findings demonstrate that indocyanine green may be used for cardiac output determinations in animals containing radioactive materials. In another experiment, the absorptivity of dilute, aqueous solutions of dye was decreased, from 15% following 500 rad to over 90% after 20,000 rad. However, such dilute solutions of indocyanine green would not be used in routine cardiac output determinations, and standard solutions of dye were not significantly altered by radiation. (BBB)

50265 RESTING PLACES, DISPERSAL, AND SURVIVAL OF ^{60}Co-TAGGED ADULT RHODNIUS PROLIXUS. Gomez-Nunez, J. C. (Instituto Venezolane de Investigaciones Cientificas, Caracas). J. Med. Entomol., 6: 83-6(Jan. 1969).

Methods of tagging R. prolixus, the most important vector of Chagas' disease of Venezuela, with ^{60}Co and the survival and dispersal of the radioactive insects are described. An improved method was used for internally placing gold-covered ^{60}Co wires. No tags fell from the insects. Gold covering was necessary to prevent corrosion and Co intoxication of the tagged specimens. The gold-covered ^{60}Co wires, 1.00 mm long, 0.12 mm in dia, and each with an activity of ~75 μCi, were inserted into the connexivum of 100 R. prolixus which were tranquilized by CO_2. To avoid excessive irradiation and detection interference, a larger sample was not used. Laboratory observations indicated that the tagging method did not alter R. prolixus longevity nor its measurable motility for a period of at least 40 days. Two habitats, palm trees and human dwellings, were chosen for field tests. Detection of individually tagged specimens was possible up to a distance of 7 m. Insects released on palms abandoned them during the initial 5 days, and only 12.9% remained on the palms. House-released R. prolixus produced different results; 41.4% left the house during the first 5 days and after this no further emigration occurred.

The use of inserted radioisotope wires for tagging gave satisfactory results. (BBB)

Metabolism, Physiology, and Toxicology

Refer also to abstracts 49725, 49726, 49749, 49750, 49989, 50004, 50395, 50397–50399, 50461, 50465, 50472, 50475, 50515, 50521, 50621, 50699, 50704, 50706, 50775, 50845, 50860, 50866, 50925, and 50963.

50266 (AEC-tr-7089) METABOLISM AND TOXICITY OF THERAPEUTIC CHELATING AGENTS. REPORT NO. 5. THE PHYSIOLOGICAL DILUTION SPACE OF EDTA AND DTPA. Bohne, Felicitas; Harmuth-Hoene, Anna-Elisabeth; Kuerzinger, Klaus; Havlicek, Frantisek. Translated by A. A. Horvath for Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex., from Strahlentherapie, 136: 609-16(1968). 16p. Dep. CFSTI.

The serum clearance of ^{14}C-labeled Ca-EDTA as well as Ca- and Zn-DTPA as a function of dose was determined in rats. The clearance is multiexponential: ≧99% of the chelates are cleared with a half-time of 17 minutes while the remaining fraction, which is larger in the case of EDTA than with DTPA, has a half-time of ≧20 hr. Chelate doses and the kind of chelated metal ion are without influence. The physiological dilution space of the chelates corresponds to the extracellular water. There is only a very slight intracellular accumulation of ^{14}C. It could be shown by experiments with ligated kidney vessels, as well as by a compartmental analysis and by electrophoretic separation of blood plasma that the slow term of the clearance function is not due to a rediffusion of the chelates from the intracellular space but to binding of the chelates or their metabolites, respectively, by the plasma proteins. (auth)

50267 (BNWL-1051(Pt.2), pp 223-5) USE OF ^{235}Np FOR HUMAN METABOLISM STUDIES. McConnon, D. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Neptunium-235 has a half-life of 410 days, decays primarily by electron capture to ^{235}U, and may be useful in determining metabolic parameters of neptunium in human volunteer test subjects. In only 0.0016% of its disintegrations, ^{235}Np decays by emission of a 5.02 MeV alpha particle to ^{231}Pa. Both daughter radionuclides are extremely long-lived and contribute little to the dose following intake of ^{235}Np. Neptunium-235 is produced by the (d,2n) reaction in a cyclotron bombardment of high-purity ^{235}U (99.9+%) with 18 MeV deuterons. Based on experimental measurements of K and L x ray energies and yields, the doses to selected critical organs of a standard man from intravenous injection and from ingestion of ^{235}Np were calculated using ICRP parameters. It is anticipated that in an experiment involving human volunteer test subjects approximately 2 μCi of ^{235}Np would be necessary for intravenous injection in order to permit external measurements of body distribution by whole body counting. This quantity would result in a maximum total dose of 50 mrem to the critical organ, the kidneys. Similarly, in an ingestion experiment, the required quantity of ^{235}Np would be 20 μCi resulting in a maximum total dose to the lower large intestine of 18 mrem. These doses are less than 1% of the maximum permissible annual limits for occupational exposure as specified by the ICRP. (E.R.B.)

50268 (BNWL-1051(Pt.2), pp 225-6) EFFECT OF DTPA ON EXCRETION OF PROMETHIUM IN HUMANS. Palmer, H. E.; Crook, G. H.; Nelson, I. C. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The effect of the calcium-trisodium salt of diethylenetriaminepentaacetic acid (DTPA) on the distribution and excretion of ^{143}Pm in humans was studied as a function of the time interval between the injection of ^{143}Pm and administration of DTPA. The retention of ^{143}Pm with time up to 6 days after injection for six subjects who were given DTPA and the average retention of ^{143}Pm in six subjects not given DTPA are presented. The excretion of the injected ^{143}Pm varied from 100% of dose for the case where DTPA was injected 5 min before the ^{143}Pm injection to only 20% of dose when DTPA was administered 24 hr after the ^{143}Pm injection. These results indicate that DTPA is very effective in significantly reducing the body content of promethium when administered within about 1 hr after the internal deposition. If the DTPA is given five or more hours later, the body burden will decrease by only 50% or less. To study the effect of DTPA on long term internal depositions of promethium, DTPA was given to two subjects 80 days after a previous injection of ^{143}Pm. Urinary excretion measurements indicated that only about 5% of the body content of ^{143}Pm was excreted during the following week. (E.R.B.)

50269 (CEA-R-3542) DETERMINATION OF IRON ABSORPTION AND EXCRETION BY WHOLE-BODY COUNTING. Hollard, Daniel; Benabid, Yvette; Berard, Martine; Bonnin, Jean; Darnault, Jean; Millet, Marcel (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Aug. 1969. 20p. (In French). Dep. CFSTI (U. S. Sales Only).

Using a whole-body counter, ^{59}Fe absorption and loss in 8 normal subjects and in 30 iron deficient patients was studied. Results showed that whole-body counting provided an excellent and simple method for iron retention measurements, obviating many inaccuracies of previous techniques. Normal absorption of radio iron with this procedure ranged from 9 to 20% of the administered tracer in normal subjects, with a mean of 15%. A significant increase in ^{59}Fe absorption was noted in 21 iron-deficient patients in whom the retention ranged from 40 to 100%. However, 3 iron-deficient patients were found to have low absorption, and their severe iron deficiency could be correlated with this malabsorption. This method permits also the determination of the rate of iron excretion during the following months and therefore the study of the mechanism of pathological loss. (auth)

50270 (COO-1339-23) ANIMAL METABOLIC STUDIES OF STRONTIUM AND CALCIUM WITH SPECIFIC REFERENCE TO FALLOUT RADIONUCLIDES. Sixth Progress Report, August 16, 1968–August 15, 1969. (Illinois Univ., Urbana). Contract AT(11-1)-1339. 23p. Dep. CFSTI.

Summaries and significant results are presented for research on kinetic studies of ^{47}Ca in goats with respect to dietary levels of Ca and P and diabetes or ovariectomy; kinetic studies of ^{32}P metabolism in goats with respect to dietary levels of Ca and P; kinetic study of ^{47}Ca metabolism in cows with respect to age; ^{85}Sr retention in swine with respect to breed, piglet separation, and dietary levels of Ca and P; hydroxyproline excretion in swine as a function of age; hypophysectomy of swine with yttrium-90; effects of thyroparathyroidectomy on ^{85}Sr retention in beagles; and transcapillary movement of radioisotopes of Ca, Sr, and Na in the muscle of dogs. A list of the technical reports (21) stemming from this research is included. (C.O.)

50271 (COO-1339-24) ANIMAL METABOLIC STUDIES OF STRONTIUM AND CALCIUM WITH SPECIFIC REFERENCE TO FALLOUT RADIONUCLIDES. Second Comprehensive Report, August 16, 1966–August 15, 1969. (Illinois Univ., Urbana). Contract AT(11-1)-1339. 18p. Dep. CFSTI.

A brief synopsis is presented of the originally stated research objectives for the period December 1966 to November 1969 in relation to ^{47}Ca kinetic studies in goats and the retention of ^{85}Sr in swine. Research accomplishments are discussed and plans for future work are outlined. (C.O.)

50272 (COO-1339-32) EFFECT OF TIME ON DISTRIBUTION OF INJECTED RADIOSTRONTIUM IN THE SKELETON OF SIX-MONTH-OLD SWINE AND ITS RELATION TO CALCIUM ACCRETION AND BONE GROWTH. Anderson, J. J. B.; Greenfield, J. W.; Posada, J. R.; Cupp, M.; Crackel, W. C. (Illinois Univ., Urbana. Dept. of Veterinary Physiology and Pharmacology). [1968]. Contract AT(11-1)-1339. 17p. Dep. CFSTI.

The distribution of ^{85}Sr was examined in 13 selected bones of the skeleton of 8 Hampshire pigs, intravenously dosed at 6 months of age. The pigs were killed from 24 hours to 180 days post-injection, at which time bones were removed, cleaned, ashed and assayed for ^{85}Sr as well as total stable calcium. The calculated % of injected dose per gram of calcium showed not only the expected decrease with time but also a remarkable constancy in the selected bones of a given animal. Grouping of the bones according to type, I (head bones), II (long bones) and III (vertebrae), revealed differences in net calcium accretion, which was greatest (132%) in long bones 180 days post-injection, and in ^{85}Sr retention, which was also greatest in the long bones 180 days post injection. Accretion and resorption of the three bone groups are discussed with respect to calcium accretion and ^{85}Sr removal during the period from 6 months to one year of age; and it appears that two types of bone growth exist during this period: accelerated accretion with normal resorption; and normal accretion with decreased resorption. (auth)

50273 (COO-1339-35) ^{47}Ca KINETICS IN CATTLE AS A FUNCTION OF AGE. Anderson, J. J. B.; Crackel, W. C.; Twardock, A. R. (Illinois Univ., Urbana. Dept. of Veterinary Physiology and Pharmacology). Sept. 9, 1969. Contract AT(11-1)-1339. 13p. Dep. CFSTI.

Eleven non-pregnant, non-lactating cattle ranging in age from 6 months to 9 years were used in a ^{47}Ca kinetic study of the readily exchangeable calcium pool as a function of age. After analysis of the plasma specific activity curves with increasing time, the kinetic parameters of this pool were shown to change as follows: pool size increased from 40 to 60 gm at 6 months to 90 at 12 months and then decreased to a value of about 35 gm in older cows; pool biological half-life fell slightly from 6 months to about 20 hr at 12 months and subsequently rose to a maximum of 35 to 40 hr in mature animals; and pool transfer rate, an index of turnover; in-

creased from 6 to 12 months to a high of about 2.5 gm/hr and gradually declined to a low of approximately 0.75 gm/hr in mature cows. These results confirmed earlier findings in goats. When pool size was considered on a per Kg body weight basis, a maximum of 10 gm/Kg was observed in cattle at 6 months and was followed by an exponential decline to a minimum of 0.2 gm/Kg in older animals. The same effect was observed when the pool transfer was considered with respect to body weight. The transfer rate in gms Ca/hr/100 Kg body weight ranged from 1.2 to 0.2 in cattle 6–12 months to 9 years of age, respectively. Blood calcium concentrations fell only slightly but significantly with increasing age. A brief discussion of the possible effects of growth and the onset of puberty on the readily exchangeable calcium pool is made.

50274 (COO–1339-36) ^{47}Ca KINETICS IN GOATS AS A FUNCTION OF AGE AND DURING PREGNANCY AND LACTATION. Anderson, J. J. B.; Kuo, Y.-H.; Crackel, W. C.; Twardock, A. R. (Illinois Univ., Urbana. Dept. of Veterinary Physiology and Pharmacology). [1969]. Contract AT(11-1)-1339. 25p. Dep. CFSTI.

An experimental study of the ^{47}Ca kinetic parameters of the readily exchangeable calcium pool (RECaP) of dairy goats was undertaken to evaluate their dynamic changes as a function of pregnancy, parturition, and lactation for a period of two years. Goats were injected intravenously with about 15 μCi ^{47}Ca every 2 to 4 weeks and, from blood samples drawn at several intervals up to 150 hr post-injection, a plasma specific activity curve was constructed. From this plot the size (E), biological half-life (T ½) and transfer rate (TR), an index of turnover, of the RECaP were calculated. As gestation proceeded T ½ drastically fell from about 35 to a low of about 15 to 20 peri-parturition, whereas E increased only slightly in the last few weeks prior to kidding. During lactation E and T ½ underwent dramatic excursions up and down in synchrony as milk production remained high and subsequently at drying off returned to normal pre-gestational values of about 5 gm and 30 hr. Changes in TR reflected the fetal and lactational demands for calcium. Kinetic parameters of non-pregnant non lactating mature female goats remained nearly constant over the period of two years in great contrast to goats passing through successive reproductive stages. However, study of these mature and other young immature goats demonstrated that E decreased and T ½ increased as a function of age from 11 months and on. Milk specific activity curves mirrored the plasma curves when lactational time lag was considered. Blood calcium concentrations fell slightly during late pregnancy and even more so during lactation. (auth)

50275 (COO–1339-37) ^{85}Sr RETENTION SWINE AS A FUNCTION OF AGE AND DIETARY CALCIUM AND PHOSPHORUS INTAKE. Anderson, J. J. B.; Crackel, W. C. (Illinois Univ., Urbana. Dept. of Veterinary Physiology and Pharmacology). Sept. 3, 1969. Contract AT(11-1)-1339. 21p. Dep. CFSTI.

Several litters of standard-size swine of different breeds were studied to determine the effects of age and dietary calcium and phosphorus intake at two different levels on their retention of administered ^{85}Sr up to 200 days post-injection (P.I.). Animals injected at birth and 6 months of age maximally retained ^{85}Sr, 28%, as measured at day 200 P.I., whereas pigs injected any time between those ages retained less of the radionuclide. Retentions by swine on either a high Ca : P intake (1.2% : 0.8%) or recommended intake (0.8% : 0.6%) were not significantly different, although pigs on the higher intake did retain more ^{85}Sr. However, this difference was removed when the groups on the two intakes were compared by dividing the amount of ^{85}Sr eliminated by net gain in weight over the 200 day experimental period. The retention data were fit better mathematically by a two-exponential function than by a modified power function. In absolute amounts swine injected near birth retained more ^{85}Sr than animals dosed at any other age. Comparison of retention behavior in swine and dogs as models for studying man is made. (auth)

50276 (COO–1758-17) LOW DIETARY IODINE INTAKE AND THE FUNCTIONAL ACTIVITY OF THE RAT THYROID. Sinha, K. N.; Anderson, R. R.; Turner, C. W. (Missouri Univ., Columbia. Dept. of Dairy Husbandry). [1969]. Contract AT(11-1)-1758. 22p. Dep. CFSTI.

The effects of low dietary iodine intake on the functional activity of the thyroid were studied in young female albino rats. Experiments were conducted with two low iodine diets containing less than 0.05 and 0.06 ppm iodine, with casein as the primary protein source. Feeding these diets to rats for periods of up to 2 and 3 months did not decrease significantly the thyroid hormone secretion rate (TSR), but PBI and thyroid size were increased slightly as compared to the corresponding control rats fed Purina Lab Chow. Fecal loss of ^{131}I was observed to be higher in the low iodine diet group of rats as compared to those consuming Purina food. On the low iodine diet, the percentage uptake of thyroidal ^{131}I was greatly increased and the biological half-life of thyroidal-^{131}I was significantly reduced, indicating a faster turnover of thyroidal iodine (hormones). It was concluded that under these experimental conditions the rat thyroid has the capacity to increase its activity to compensate for any moderate low dietary iodine for at least 2 to 3 months. (auth)

50277 (NYO–2043-195, pp 39-62) GLOEOSPORIUM MUSARUM AND COLLETOTRICHUM GLOEOSPORIOIDES: PHYSIOLOGY AND HOST–PARASITE INTERACTIONS ON BANANA FRUITS. Greene, G. L.; Proano, V. A.; Morales, C. (Inter-American Inst. of Agricultural Sciences, Turrialba (Costa Rica)).

Host-parasite interactions that cause spoilage of tropical fruits were investigated by a comparison of metabolic processes in banana fruit infected with a virulent banana fruit rotting organism, Gloeosporium musarum, and a closely related fungus, Colletotrichum gloeosporioides. Colletotrichum gloeosporioides causes severe rotting on other tropical fruits such as avocado and papaya, but is saprophytic or weakly parasitic on banana. Results are reported from metabolic studies on the two fungi on bananas at various stages of ripeness and on culture media. (C.H.)

50278 (ORO–3459-4) SELECTIVE ABSORPTION AND ACCUMULATION OF STRONTIUM BY PLANTS. Final Report. Collins, H. A. (Tuskegee Inst., Ala.). Jan. 15, 1969. Contract AT(40-1)-3459. 39p. Dep. CFSTI.

The selectivity of plant species (46 species representing 13 families) in absorbing and accumulating stable strontium and strontium-85 from two types of soil (Crofton or Norfolk) and the effects of exogenous applications of stable strontium and a nitrogen, phosphorus, and potassium fertilizer on such selectivity were studied. Results showed differences in strontium content with species, with soil type, and with fertilizer application. Correlations with calcium content and other cations were examined. Patterns of strontium-85 absorption by plant species were not much different from those for stable strontium. Of particular interest was the finding that addition of stable strontium to Norfolk soil did not enhance the concentration of strontium-85 as it did for stable strontium. (C.O.)

50279 (PHS–999-RH-33, pp 45-50) COMPARATIVE METABOLISM OF SELECTED RADIONUCLIDES IN ANIMALS. Stara, J. F.; Nelson, N. S. (National Center for Radiological Health, Cincinnati, Ohio. Radionuclide Toxicology Lab.); Della Rosa, R. J.; Bustad, L. K. (California Univ., Davis. Radiobiology Lab.).

The metabolism of radiocesium, radiocalcium, radiostrontium, radium, radiozinc, plutonium, radioiodine, polonium, radiolead, and radioruthenium was compared in various animals. (F.M.M.)

50280 (UR–49-1153) STUDIES WITH RADIOTHORIUM (^{228}Th) ENRICHED THORIUM DIOXIDE AND ITS RADIOACTIVE PROGENY. Ballou, John Edgerton (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). 1969. 154p. Dep. CFSTI. Thesis.

The ^{224}Ra and ^{212}Pb daughters in ThO_2 were preferentially solubilized and translocated from deposits of the oxide in muscle, in the major reticuloendothelial organs and from the lung air space and vascular system. The extent of the washout varied with the primary site of ThO_2 deposition, but as a rule the lead isotope was depleted (relative to ^{228}Th) to a twofold greater extent than its radium precursor. A major portion of the ^{212}Pb deficit (40 ± 9 percent of that washed from an inhaled deposit in lung) could be attributed to loss of the immediate parent of ^{212}Pb, thoron, in the expired air. The balance of the translocated ^{212}Pb accumulated in red blood cells and liver in the ratio of 5 : 1, respectively. The concentration of ^{212}Pb in blood appeared to reflect the amount of ThO_2 in the dog, regardless of deposition site, and maintained a ratio of blood ^{212}Pb(nCi/g)/lung ^{228}Th(μCi) = 0.083 ± 0.027 over a retention period from 3 to 150 days. For 11 dogs exposed to inhaled ThO_2 the ratio was 0.084 ± 0.012 over the same retention period. The ^{224}Ra washed from ThO_2 deposits accumulated in bone (~90%) or was excreted (~5%) in the ratio urine/feces = 0.5. Radium-224 in bone was depleted in ^{212}Pb(^{212}Pb/^{224}Ra = 0.8 ± 0.05) due to the combined losses of thoron by diffusion and ^{212}Pb by mobilization. The depletion of ^{212}Pb in bone was obvious by the third day after inhalation of ThO_2. Thoron was released into the lung space from inhaled ThO_2 to the extent of 18 ± 3 percent of that produced by the ^{224}Ra in lung. Thoron release was approximately one-half this value from deposits in lung that originated from systemically injected ThO_2; even less was released from primary deposits of ThO_2 in muscle. The clearance of ThO_2 from the lung was estimated on the basis of measurements over the thorax during a 150-day retention interval. Values for the half-life of clearance were 235 and 290 days, respectively, for the long-term component. The relative concentrations of ^{228}Th, ^{224}Ra, and ^{212}Pb in tissues at "steady state" were expressed in terms of the initial LRT burden extrapolated from the long-term clearance phase. These concentrations of the daughters were dis-

cussed in terms of their application to the estimation of industrial exposures to ThO_2 and the calculation of radiation dose subsequent to ThO_2 incorporation. (auth)

50281 COMPARATIVE STUDIES OF THE DECORPORATION EFFECTIVITY OF D-PENICILLAMINE, PENICILLOIC ACID, AND PENILLOIC ACID. Boehme, P.; Catsch, A. (Kernforschungszentrum, Karlsruhe, Ger.). Arzneim.-Forsch., 17: 19-22 (Jan. 1967). (In German).

Effects of d-penicillamine (PA), penicilloic acid (PC5), and penilloic acid (PS) on retention of ^{60}Co in rats were studied. Following simultaneous administration of PA with ^{60}Co, organ retention was generally decreased in proportion to the dose of Pa given. Effects of PC5 and PS were similar, but were less than those of PA. The results indicated the possibility that PC5 and PS may have been degraded to PA in vivo, and may have exerted their effects on organ retention of ^{60}Co because of the formation of chelates. (BBB)

50282 THE COURSE OF THYROID UPTAKE IN HUMANS TREATED WITH INSULIN AFTER SATURATION OF THE THYROID WITH ^{131}I. Blum, C.; Bru, A.; Sendrail, M. (Faculte de Medecine, Toulouse). Ann. Endocrinol. (Paris), 30: 120-3 (Jan.-Feb. 1969). (In French).

The effect of insulin on thyroid ^{131}I metabolism was studied in 21 human subjects. The subjects were first administered 20 μCi ^{131}I per day for 7 days; then, when radioiodine treatment was stopped, were given insulin injections. In the absence of insulin treatment ^{131}I uptake by the thyroid continued to increase for several days after cesation of ^{131}I administration. On the contrary, it continued to decline sharply in all insulin-treated subjects. It is suggested that insulin mobilizes a thyroid hormone that has already become labeled with ^{131}I, and in this sense exerts a thyroid-stimulating action. (BBB)

50283 RELEASE OF INTRAVENOUSLY ADMINISTERED IODIDE FROM THE PIAL AND DURAL SURFACES. Van Harreveld, A.; Ahmed, Nawal (California Inst. of Tech., Pasadena). Brain Res., 11: 32-41 (Oct. 1968).

The release of radioiodide from the cerebral cortical and dural surface of rabbits was investigated by collecting cortical washings before and after the intravenous administration of 150 to 300 μCi $Na^{131}I$. Since the iodide release from the cortex was expected to be small and the count in the serum after the intravenous administration of radioiodide to be high, small bleedings not readily showing up in the washings, could result in an appreciable count in the perfusate. As a check on the bleeding, 150 μCi of albumin-^{131}I was injected 15 to 20 min before the administration of ^{131}I. Since the albumin-^{131}I does not readily pass the vessel wall, the presence of ^{131}I in samples collected during this time provided an estimate of the bleeding. The concentration of free radioiodide increased markedly in successive 1-ml samples of cerebrospinal fluid (CSF) collected 20 hr after administration of $Na^{131}I$. This is explained by assuming that a fluid with a higher ^{131}I content than the CSF is formed by the pial and dural surfaces which flows to the cisterna from where the CSF is collected. This was supported by the release of radioiodide in cortical washings after the administration of $Na^{131}I$. Using a correction for the ^{131}I in the washings due to bleeding as made by the administration of albumin ^{131}I before $Na^{131}I$ administration, a mean clearance of iodide of about 0.45 $\mu l/cm^2/min$ was found. Also a release of radioiodide from an isolated dural tube perfused with artificial CSF was demonstrated. The release computed per cm^2 was similar to that of the cortical surface. (BBB)

50284 ABSORPTION OF GOLD SALTS AND GOLD SOLS FOR THERAPEUTIC USE. Kleinsorge, Hellmuth (Univ., Jena, Ger.). Arzneim.-Forsch., 17: 100-2 (Jan. 1967). (In German).

The absorption of ^{198}Au in the form of therapeutic preparations for human use was studied by histochemical and spectrographic methods. The enteral absorption of ^{198}Au salts and sols administered by mouth or by rectum was investigated. Gold in colloidal solution was made absorbable by the addition of potassium iodide that promoted further the absorption of gold salts. About 13% of the ^{198}Au administered was absorbed by humans and excreted quickly. A saturation effect cannot be obtained even by prolonged Au administration. Gold concentrations in the serum and the organs never surpassed a certain limit, since the excretion of gold increased considerably with a rise of the serum concentration. Electrophoretic investigations showed that highly soluble gold salts, such as potassium tetrabromoaurate, are bound to the serum proteins and cannot be reduced, while other compounds such as sodium thiosulfatoaurate undergo a temporary deoxidation. Colloidal Au is stabilized by the protective colloid effect of serum protein. Most ^{198}Au in serum is associated with the α_1-globulins. (BBB)

50285 ^{22}Na RETENTION AND 17-HYDROXYCORTICOSTEROID EXCRETION IN AFFECTIVE DISORDERS: A PRELIMINARY REPORT. Baer, Leslie; Durell, Jack; Bunney, William E.; Levy, Bernard S.; Cardon, P. V. (National Inst. of Mental Health, Bethesda, Md.). J. Psychiat. Res., 6: 289-97 (May 1969).

A method of whole-body counting was developed for determining ^{22}Na retention under various states, and was tested in four patients. Two patients were on a 5-g salt intake, and two on a 10-g salt intake. Ten μCi of ^{22}Na(chloride) was injected intravenously, and the patients were positioned in the whole-body counter for estimation of total-body radioactivity $\frac{1}{2}$ hr later and on subsequent days thereafter for periods ranging from 54 to 81 days. The probe of the counter consisted of an 8 × 4 in Tl-activated NaI crystal located in a low-background steel-shielded room. A multi-channel analyzer was used and the counts under the 1.28-MeV γ photopeak of ^{22}Na were recorded and corrected for physical decay. A minimum of 10,000 counts were obtained on each occasion. Overall curves of ^{22}Na retention plotted on a semi-logarithmic scale of cpm (corrected for physical decay) were approximately linear. Patients on a 10-g Na intake had slopes about two times greater than those on a 5-g intake. The ^{22}Na retention was evaluated during different segments of clinical course. Each patient's course was divided into depressed, less depressed, recovered and/or hypomanic. Three of the four patients exhibited greater isotope retention when depressed, and in two patients the results were statistically significant. In patients with endogenous depression 17-hydroxycorticosteroid excretion was higher during the depressed periods than during the other periods, correlating with the increased ^{22}Na retention. (BBB)

50286 THE RHYTHM OF ^{35}S SUPPLY AND INCLUSION INTO THE CORN ROOT PROTEIN. Abutalybov, M. G.; Mardanov, A. A.; Safaraliev, P. M. Dokl. Akad. Nauk SSSR, 185: 954-6 (Apr. 1, 1969). (In Russian).

Corn plants of 5 to 15 days age were transferred to a 0.5 normal Knopp solution containing 200 μCi of ^{35}S per liter. The amount of absorbed ^{35}S was found by measuring the activity of the feed solution before and after exposure to the plant. The protein fraction was isolated from the root by grinding with 0.2% NaOH and treatment with 5% tricholoroacetic acid (TCA). The ^{35}S activity of the protein precipitate was counted on an end-window counter. The data show a clear rhythm in protein synthesis of the corn root of 15 day old plants with four to five maxima and minima being observed in the course of a 24 hr period. The data give a basis for supposing that there is a definite connection between the supply of radioactive sulfate ions and the periodicity in the synthesis of protein acceptors. (TTT)

50287 RADIOAUTOGRAPHIC STUDIES OF THE DISTRIBUTION OF ^{125}I IN THE TRACHEAL MUCOSA AND PAROTID GLAND OF THYROIDECTOMIZED GUINEA PIGS. Hoebel, M.; Lehrnbecher, W. (Univ., Heidelberg). Z. Gesam. Exp. Med., 144: 24-30 (1967). (In German).

Distribution of ^{125}I in the tracheal mucosa and parotid gland was studied in thyroidectomized guinea pigs. The animals were given a 500-μCi dose of ^{125}I and killed 5 hr later. By use of autoradiography of frozen sections it was demonstrated that ^{125}I is present in the exretory epithelium cells of the tracheal mucosa. Goblet cells do not appear to play any role in the radioiodine metabolism of the tracheal wall. In the parotid gland ^{125}I was located mainly in epithelial cells of the duct system. Sometimes a very small amount of radioiodine was found in the cells of the acini. (BBB)

50288 THYROIDAL RADIOIODINE UPTAKE AND THYROTROPIC POTENCY OF THE PITUITARY IN A FRESHWATER CATFISH, MYSTUS VITTATUS (BLOCH), IN RESPONSE TO L-THYROXINE, ANTITHYROID DRUGS, AND HEAVY DOSES OF ^{131}I. Singh, T. P. (Banaras Hindu Univ., Varanasi, India). Z. Zellforsch. Mikroskop. Anat., 94: 172-80 (Jan. 20, 1969).

Experiments were conducted on the thyroid ^{131}I uptake and thyrotropic potency of the pituitary gland in a freshwater catfish, in response to L-thyroxine, antithyroid drugs, and large doses of radioiodine. L-thyroxine treatments slightly lowered thyroidal radioiodine uptake, and there was at least a trend of lowered thyrotropin (TSH) content in the pituitaries of these animals. Administration of antithyroid drugs (propylthiouracil, thiourea, KSCN) caused a significant decrease in radioiodine uptake and a highly significant increase in TSH content of the pituitary. Heavy doses of ^{131}I almost completely blocked thyroid iodine uptake and were as effective as antithyroid drugs in elevating TSH content of the pituitary. The thyroid radioiodine uptake was reduced markedly either when thiourea treatment was supplemented with a single injection of 400 μCi of ^{131}I or by a heavy dose of radioiodine (800 μCi) alone. Thyroidectomy in Mystus vittatus, even with such a high dose of ^{131}I, was not complete. (BBB)

50289 EFFECT OF SELECTED DIETARY FACTORS ON RADIOSTRONTIUM ABSORPTION AND RETENTION IN THE RAT. Light, James Melvin. Bloomington, Ind., Indiana Univ., 1968. 317p.

Thesis.

Radiostrontium, because of its chemical and biological similarities to calcium, substantial fission yield, long half-life, and facile incorporation into biological systems, is a potential health hazard to man. Once absorbed, radiostrontium is similar to calcium in that most of it becomes incorporated into the skeletal system, where its penetrating β radiation into skeletal tissue and hematogenic bone marrow can result in bone tumors and leukemias. A series of laboratory experiments was conducted to explore the possibilities of altering radiostrontium metabolism nutritionally. The effects of various dietary additives on radiostrontium absorption and retention in the rat were examined. Mono (^{89}Sr) and dual (^{89}Sr + ^{45}Ca) isotope techniques were employed. Radiochallenges were administered to the experimental animals either orally or parenterally in single or regularly repeated dosages. Specific experiments were conducted for periods from three weeks to eight months in order to observe age-related changes in radiostrontium metabolism and to evaluate the altered diets on the growth and development of the laboratory animals. Excretion, femur, and carcass samples were monitored for radioactivity and compared to control animal samples. Stable calcium and phosphorus determinations were also performed. Results were computed and analyzed cybernetically. Enhanced dietary calcium depressed radiostrontium skeletal retention somewhat, primarily by increasing the urinary excretion of the absorbed radiostrontium. Unfortunately, dietary calcium supplementation was not well accepted by the experimental animals, as was shown by their significantly decreased ash weight values in each experiment. The severe calcium influence on normal growth and development was ameliorated by simultaneously increasing dietary phosphate. Elevating both calcium and phosphate in the diet fed to the experimental animals permitted more normal growth patterns, besides reducing the radiostrontium skeletal retention more than either constituent could do alone. Enhanced dietary phosphate alone increased absorbed radiostrontium skeletal retention, since phosphate tended to depress alkaline earth metal urinary elimination. However, when given the opportunity to mix in the intestine before absorption, strontium and phosphate formed slightly soluble associations that elevated radiostrontium fecal excretion and ultimately caused a slight reduction in radiostrontium skeletal retention. Additional dietary fluoride from 1 to 50 ppm had little effect on radiostrontium skeletal retention during the 100-day period after weaning. However, rats that received 50 ppm F supplementation for four months and longer reduced radiostrontium skeletal retention. It was assumed that this was actual skeletal protection as fluoride had essentially no effect on radiostrontium absorption or excretion. Sodium alginate supplementation proved to be the most efficacious additive against radiostrontium absorption and retention. Added to the diet at the 5% level, sodium alginate depressed radiostrontium intestinal absorption and, correspondingly, skeletal retention by 60 to 80% compared to control conditions. In addition to achieving the most significant reductions in radiostrontium absorption and retention, sodium alginate also demonstrated selective binding properties toward strontium that significantly improved the natural biological discrimination against strontium relative to calcium. It was concluded that nutritional modification to prevent radiostrontium uptake and retention was largely ineffective except for one additive: sodium alginate. Furthermore, it was suggested that there are probably additional agents that may preferentially bind radiostrontium and that the search for such agents would be the most promising approach in attempting to reduce the potential biological hazards associated with radiostrontium. (Disser. Abstr.)

50290 WHOLE-ANIMAL AUTORADIOGRAPHY: A METHOD OF DRUG RESEARCH. Patzschke, Karl (Isotopes-Institut der Farbenfabriken Bayer AG, Elberfeld, Ger.). Muenchen. Med. Wochenschr., 110: 2043-53(Sept. 6, 1968). (In German).

Methods and applications of whole-body autoradiography to follow the tissue distribution, metabolism, and excretion of radioisotope-labeled drugs are reviewed. While radioactivity measurements may disclose the functional behavior of the drug in the body, autoradiography is mainly suitable to demonstrate morphologically the distribution of activity of the drug and its metabolites in the tissues. Whole-animal autoradiography is particularly illustrative of the relative concentrations of activity in the organs involved. Examples are cited to illustrate the recognition of selective accumulations of radioactively labeled pharmaceutical substances in the entire animal. Conclusions may be drawn from such findings as to the biological functions and relations between pharmacodynamic action and selective accumulation and to drug residues. (BBB)

50291 AN ONTOGENETIC STUDY OF THE EFFECTS OF EXPOSURE TO X IRRADIATION ON THE PHARMACOLOGY OF BARBITURATES. Nair, Velayudhan (Michael Reese Hospital, Chicago). Chicago Med. Sch. Quart., 28: 9-25(1969).

The effect of irradiation of fetal and adult rats on barbiturate metabolism was studied after whole-body doses of 500 or 1000 R and head irradiation of 5000 or 10,000 R with x rays. Prenatal irradiation resulted in an impairment of the development of the hepatic microsomal enzyme system metabolizing hexobarbital in the male offspring. These animals resembled the females with respect to the activity of this detoxification system. As expected, there was an increase in the duration of hexobarbital hypnosis in these male offspring of irradiated mothers in comparison to the control rats of the same age. Suppression of development of the enzyme system was also noted after early postnatal irradiation, except that a higher radiation dose was necessary. Inhibition of the enzyme system, both direct and abscopal, was observed in adult males also (i.e., after the enzyme level has reached a plateau) but only at radiation doses above 500 R (total body or liver) or above 1000 R (head alone). In adult rats, by using different types of barbiturates (thiopental, pentobarbital, hexobarbital, barbital) it was shown that both the onset and duration of hypnosis were enhanced in head-irradiated animals. Earlier onset of drug action was related to faster drug entry into brain resulting from radiation-induced blood-brain barrier alterations. Prolongation of drug action is partly the result of a sensitization phenomenon and a region specific rise in brain serotonin is perhaps involved in this sensitization, and partly the result of an inhibition of the hepatic hexobarbital oxidase. Radiation-induced inhibition of the hepatic hexobarbital oxidase is of abscopal nature and is mediated through hormonal regulation of enzyme activity. (BBB)

50292 VARIATIONS IN THE PHOSPHATE CONTENT OF HISTONE F1 IN NORMAL AND IRRADIATED TISSUES. Stevely, W. S.; Stocken, L. A. (Oxford Univ.). Biochem. J., 110: 187-91(Nov. 1968).

The capacity of the histone-DNA complex to act as a template for RNA synthesis is increased by phosphorylation of histone F1. In regenerating liver DNA synthesis is preceded by phosphorylation of histone F1. Exposure to ionizing radiation in vivo decreases and delays the phosphorylation of histone F1 in regenerating liver, and decreases it in the hyperplastic kidney. Histone F1 is phosphorylated to a greater extent in dividing than in resting tissues. (auth) (UK)

50293 DETERMINATION OF CREATININE IN THE URINE AS AN INDICATOR OF THE PERIODS OF METABOLIC ACTIVITY, IN VIEW OF ITS APPLICATION IN RADIOTOXICOLOGIC ANALYSIS. Furnica, Gh.; Turcitu, Elisabeta (Institutul de Igiena, Bucharest). Fiziol. Norm. Patol. (Bucharest), 14: 67-72(Jan.-Feb. 1968). (In Rumanian).

Urine creatinine excretion was studied with a view to establishing an indicator of the metabolic periods in irradiated animals. Creatinuria may be used in this connection only when the determinations are done in each separate case during 24 hr and when in the case of internal contamination the irradiation is not intense. (auth)

50294 PLASMA ^{45}Ca CLEARANCE BY THE TIBIA IN THE IMMATURE DOG. Bosch, Wouter J. (Univ. of Iowa, Iowa City). Amer. J. Physiol., 216: 1150-7(May 1969).

The hypothesis that the volume rate of plasma flowing through the skeleton is not uniformly distributed among capillaries able to exchange calcium with bone mineral and capillaries unable to do so, and that this nonuniformity is a determinant of the quantity of bone mineral calcium which can exchange with the systemic circulation was investigated. This hypothesis was tested by using the Fick principle modified to measure ^{45}Ca extraction from tibial plasma in puppies perfused at various, controlled flow rates. It was found that as the total plasma flow rate increases the ^{45}Ca extraction fraction falls and the plasma clearance increases. Also ^{45}Ca clearance is not restricted by plasma flow at low rates and is not limited by capillary permeability-surface area relationships at high rates. These data best fit a model of nonuniformly perfused, parallel vascular channels in which the quantity of bone calcium able to exchange with the circulation does not increase proportionally as the total plasma flow rate increases. (auth)

50295 NEUTRON-ACTIVATION STUDIES OF TRACE ELEMENTS IN HUMAN FINGERNAILS. Kanabrocki, Eugene; Case, Lawrence F.; Graham, Leonard A.; Fields, Theodore; Oester, Y. T.; Kaplan, Ervin (Veterans Administration Hospital, Hines, Ill. Loyola Univ., Hines, Ill. Univ. of Illinois, Chicago). J. Nucl. Med., 9: 478-81(Sept. 1968).

The content of Au, Cu, Mn, and Na in fingernail clippings of 19 apparently normal subjects was determined by γ spectroscopy following neutron activation. Fingernail clippings collected from one adult male over a 15 mo period were also analyzed. The results showed variations in the content of trace elements between adults and children and also seasonal variations. (C.H.)

50296 ^{131}I ACCUMULATION IN LIVER, ESPECIALLY ON THE POSSIBILITY OF DELINEATION OF LIVER BY SCINTI-

SCANNING WITH ^{131}I. Tatsuno, Ikuo; Kato, Sotoe (National Kanazawa Hospital, Japan). Kaku Igaku, 5: No. 2, 135-41(July 1968). (In Japanese).

It was shown that the liver could be delineated by scanning in some hyperthyroidic patients following the administration of a therapeutic dose of ^{131}I. The time of maximum radioactivity of ^{131}I in the liver was 3 to 5 days after the oral administration of $Na^{131}I$. Following this peak time, radioactivity in the liver showed a decrease of 50% within 4 to 6 days, when the liver excreted radioiodine into the bile. Comparing the hyperthyroidic cases in which liver can be scintiscanned with therapeutic ^{131}I dose (Group A) with the hyperthyroidic ones in which liver cannot be scintiscanned (Group B), it was found that resin sponge uptake, basal metabolic rate, and alkaline phosphatase were higher in Group A than in Group B, and total serum cholesterol level was lower in Group A than in Group B, whereas both groups showed no significant difference in thyroid ^{131}I uptake. These characteristic findings in laboratory tests suggest the existence of a more severe grade of thyrotoxicosis in Group A. Based on the hypothesis of a close relation between the ^{131}I accumulation in the liver and the thyroid hormone level in blood, scintiscanning of the liver was attempted with ^{131}I-labeled 1-thyroxine injected intravenously. Excellent scintigrams were obtained in even the cases of Group B. This method has the advantages of reducing the radiation dose to the liver compared with one using colloidal ^{198}Au and of delineating the liver more accurately than the method using ^{131}I-rose bengal in which small artificial defects in the pattern of the liver and bowel artifacts are disturbing. It was suggested that the liver plays an important role in the regulation of the blood level of thyroid hormones. (auth) (TSS)

50297 ESTIMATION OF WATER CONTENT BY TRITIUM DILUTION OF ANIMALS SUBJECTED TO RAPID LIVE-WEIGHT CHANGES. McManus, W. R.; Prichard, R. K.; Baker, Carolyn; Petruchenia, M. V. (Univ. of New South Wales, Kensington, Australia). J. Agr. Sci., 72: 31-40(Jan. 1969).

Various problems in the use of tritiated water (TOH) to estimate total body water (TBW) of animals experiencing recovery from malnutrition were studied. The time for equilibration of TOH, given intraperitoneally, with TBW was determined in rabbits and in rats. As judged by the specific activity of blood water, equilibration occurred by 75 to 125 min in the rabbit and did not appear to be affected by the state of nutrition. However, between groups the specific activity of water obtained from the liver 180 min after injection of TOH was significantly different from the specific activity of water simultaneously obtained from the blood plasma. Thus, liver is not a suitable tissue for testing achievement of equilibration. As judged by the specific activity of blood water compared to that of water from the whole-body macerate, equilibration in mature rats either in stable body condition or undergoing rapid compensatory growth occurred in less than 60 min. A trial comparing TOH space (corrected by 3% body weight) and actual TBW (by desiccation) was conducted in rabbits during malnutrition followed by compensatory growth. Prior to malnutrition the agreement between actual and estimated TBW was satisfactory and within 2.3%. During compensatory growth the agreement was poor, the TOH values over-estimating actual TBW by 12%. (BBB)

50298 THE INFLUENCE OF CHELATING AGENTS ON THE DISTRIBUTION AND EXCRETION OF RADIOIRON IN THE RAT. Guenther, Rolf (Kernforschungszentrum, Karlsruhe, Ger.). Arch. Pharmakol. Exp. Pathol., 262: 405-18(1969). (In German).

The effect of the following 13 chelating agents on the distribution and excretion of ^{59}Fe, carrier-free or diluted with stable carrier iron in rats was studied: ethylenediaminetetraacetate (EDTA), hydroxyethylenediamine-triacetate (HEDTA), 2,2-bis-[di(carboxymethyl)amino]diethylether (BADE), diethylenetriaminepentaacetate (DTPA), triethylenetetraaminehexaacetate (TTHA), trans-cyclohexane-1,2-diaminetetraacetate (CDTA), (2-hydroxycyclohexyl)-ethylenediaminetriacetate (HCEDTA), bis(2-hydroxycyclohexyl) ethylenediaminediacetate (BHCEDA), (2-hydroxycyclohexyl)iminodiacetate (HCIDA), 2-(β-aminoethoxy)cyclohexylaminetetraacetate (ACATA), ethylene-di-(α-0-hydroxyphenyl)glycine (EDHPG), desferrioxamine B-methanesulfonate (DFOA), and D-penicillamine (PA). These compounds were intraperitoneally administered as the Ca-chelate in doses of 100 μmole/animal at the same time or after intravenous injection of 3 μCi of carrier-free ^{59}Fe (as $FeCl_3$). Simultaneous administration of chelating agents lowered the retention of ^{59}Fe in all tissues whereas after delayed treatment a smaller fraction of ^{59}Fe was removed from liver and spleen. The most effective compounds were EDHPG, ACATA, and DFOA. However, the practical use of EDHPG is limited because of its toxicity. Three of the six rats treated with EDHPG died, whereas the other chelating agents were less toxic in the doses used. (BBB)

50299 RATE OF REMOVAL OF COLLAGEN AND MINERAL FROM BONE AND CARTILAGE. Firschein, H. E.; Alcock, Nancy W. (Hospital for Special Surgery, New York). Metab., Clin. Exp., 18: 115-19(Feb. 1969).

Rates of loss of ^{85}Sr and ^{14}C-proline from bone and cartilage of young rats were determined. Male rats were given simultaneous intraperitoneal injections of 10 μCi of $^{85}Sr(NO_3)_2$ (specific activity 2550 mCi/g), and 40 μCi of L-^{14}C-proline (specific activity 8.8 mCi/mM) per 150 g of body weight. The animals were fed a diet containing 1.1% Ca and were sacrificed at one, five, 10, 15, and 20 days after injection of the radioisotopes. The specific activity of both isotopes decreased from the first day to the 20th day. The rate of decrease for ^{14}C in the proximal end of the tibia was greater than in the whole femur. In both the proximal end of the tibia and in the femur, on days 10, 15, and 20, the specific activities for ^{14}C and ^{85}Sr were almost identical. On the fifth day after injection however, the specific activity of ^{14}C was higher than the corresponding value for ^{85}Sr. In the costal cartilage the rate of decrease in the specific activity of ^{85}Sr closely resembled that in bone, but the rate of decrease in ^{14}C was less than that in bone. The results indicate that in both the proximal end of the tibia and the femur, the rates of removal of the collagen and mineral phases are identical. However, in the costal cartilage the rate of removal of collagen was markedly less than that in bone, while the rate of removal of the mineral was similar to that found in bone. (BBB)

50300 RETENTION OF ^{85}Sr IN RATS CONTAMINATED IN UTERO. Jasinski, W. K.; Watras, J.; Gwiazdowska, B. A.; Sapiecha, H. (Inst. of Oncology, Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Biol., 17: 65-8(1969).

Female rats 10 days after mating were supplied with ^{85}Sr-containing drinking water. The animals were given 14 μCi/ml daily, or a total of 140 μCi. In another experiment, on the 10th day after mating, a single dose of 30 μCi of ^{85}Sr was injected subcutaneously. The newborn rats remained with their mothers for 40 days. Their whole-body activity was measured. The retention of ^{85}Sr was several times higher after the injection than for oral administration in adult females as well as in their progeny. The effective biological half lives were shorter than the physical half-life of ^{85}Sr, showing that the nuclide is progressively removed from the contaminated females and their progeny. No statistically significant differences were found in effective half-lives for the two groups of animals. The final retention coefficients for the offspring relative to the coefficients for the mothers are given. The higher yield after oral contamination (5.3% on the average) as compared with the injection (2.9%) likely resulted from the fractionated dose, and therefore, from contaminating animals at a later state of pregnancy when the retention in the fetus increases. The data also suggested a relation between the yield of labeling and the size of the litter (the highest yield was found in the smallest litters). (BBB)

50301 FRACTIONAL EXTRACTION AND TRANSCAPILLARY EXCHANGE DURING CONTINUOUS AND INSTANTANEOUS TRACER ADMINISTRATION. Yudilevich, David L.; Renkin, Eugene M.; Alvarez, Osvaldo A.; Bravo, Ivan (Duke Univ., Durham, N. C.). Circulation Res., 23: 325-36(Aug. 1968).

The relation between extraction fraction, E, measured by the multiple-tracer, instantaneous intra-arterial injection method and by single-tracer, continuous injection was studied in anesthetized dogs. The E value was calculated from ratios of diffusible to nondiffusible tracer concentrations in successive samples of venous blood. Initial extraction, E(0), was the same by instantaneous or continuous injection. Because of back-diffusion E diminished with time. In liver, E(0) for water-^3H, mannitol-^3H, and glucose-^3H was about one, indicating that transcapillary transport was flow-limited. For ^{22}Na, ^{36}Cl, and mannitol-^3H in gastric wall, and for ^{22}Na and ^{86}Rb in skeletal muscle E(0) was less than one and decreased with increasing blood flow, indicating diffusion limitation. For ^{86}Rb in skeletal muscle E reached a plateau level. Both E(0) and plateau E for ^{86}Rb in muscle increased during exercise. Permeability surface products were calculated from measured E values and blood flows. Their values suggested that E(0) reflected relative capillary permeabilities to different tracers, but only for capillaries of fastest arteriovenous transit. Plateau E values such as for ^{86}Rb in skeletal muscle, represented all the capillaries, but were influenced by extracapillary barriers also. (BBB)

50302 EXTRACELLULAR VOLUME IN SKELETAL MUSCLE OF THE RAT AND DOG: A COMPARISON OF RADIOSULFATE AND RADIOBROMIDE SPACES. Barratt, T. M.; Walser, M. (Johns Hopkins Univ., Baltimore). Clin. Sci., 35: 525-36(Dec. 1968).

Male Sprague-Dawley rats received intraperitoneal injections of 10 μCi each of ^{35}S (as Na_2SO_4) and ^{82}Br (KBr) for a study of the inorganic radiosulfate and radiobromide spaces of the skeletal

muscle measured over periods varying from 30 min to 22.5 hr. Similar studies were conducted in dogs. The radiosulfate space was uniformly less than the radiobromide space: in the rat the mean ratio of radiosulfate space to radiobromide space was 0.80 ± 0.01 (SEM) and in the dog 0.72 ± 0.07 (SEM). These data would be explained if 20% of muscle chloride is intracellular in the rat and 28% in the dog, and suggest that radiosulfate administered in vivo would be a satisfactory substance for measuring the extracellular fluid volume of skeletal muscle. (BBB)

50303 THYROID PHYSIOLOGY IN THE DEVELOPING MONKEY FETUS (MACACA MULATTA). **Pickering, Donald E. (Childrens Diagnostic Center, Beaverton, Oreg.). Gen. Comp. Endocrinol., 10: 182-90(Apr. 1968).**

Morphological and chemical changes and ^{131}I metabolism in the fetal thyroid were studied in monkeys. Follicle formation and colloid synthesis were apparent in the gland by conception age 50 days. The total iodine content increased 50 fold from conception age 75 to 150 days yet gland weights increased only 10-fold. Monoiodotyrosine (MIT), diiodotyrosine (DIT), and thyroxine (T_4) were present in constant ratios. The 24-hr ^{131}I uptake per mg of thyroid tissue in fetuses was 8 to 12 times greater than in their mothers. The distribution of ^{131}I among these compounds was about the same in all fetal thyroid glands studied. The significant difference of T_4 ^{131}I values observed between fetal and infant thyroid glands suggested that much less T_4 is released from the gland in fetal life than after birth. Butanol-extractable iodine values in fetal glands were relatively low at the younger ages, but increased progressively and approached maternal values by conception age 150 days. By term, maternal and fetal values are equal for this animal and man. The ^{131}I-labeled T_4 detected was of maternal origin. The fetal serum T_4 values, observed from relatively long-term maternal administration of large doses of ^{131}I-labeled T_4, showed little or no change from normal even though maternal values had exceeded normal by three times. There was also no indication of increased placental T_4 transport to the fetus as a result of the high maternal T_4 values. (BBB)

50304 ON THE INFLUENCE OF DIFFERENT FORMS OF STABLE STRONTIUM ON THE ENTRY OF ^{90}Sr INTO THE PLANT IN RELATION TO THE CONDITIONS OF PHOSPHORUS AND CALCIUM FEEDING. **Skadchenko, N. M. (Inst. of Biophysics, Moscow). Vestn. Mosk. Univ., Ser. VI, Biol. Pochoved., No. 4, 106-9(1968). (In Russian).**

Increasing the concentration of stable Sr in the ground causes an increase in the uptake of ^{90}Sr and its accumulation in the harvest of oats. The accumulation is greater in the stem than in the leaves and grain. The introduction into the soil of stable Sr under the conditions of the experiment also lead to decrease in the crop. The effect of K_3PO_4 and lime and their combined influence on lowering the ^{90}Sr accumulation decreases in relation to the concentration of ^{90}Sr in the soil. The combined introduction of K_3PO_4 and lime at different concentrations of ^{90}Sr in the soil reduced the absorption of ^{90}Sr to a greater extent than the introduction of K_3PO_4 alone. Under other conditions the action of K_3PO_4 on decreasing the accumulation of ^{90}Sr in leaves and particularly in stems of oats was somewhat higher if stable Sr was introduced into the ground as chloride rather than nitrate. (BBB)

50305 COMPARISON OF PASSAGE OF A TRACER THROUGH THE GASTROINTESTINAL TRACT OF NEONATAL AND ADULT RATS. **Sikov, M. R.; Thomas, J. M.; Mahlum, D. D. (Battelle Memorial Inst., Richland, Wash.). Contract AT(45-1)-1830. Growth, 33: 57-68(Mar. 1969).**

An equilibrium solution of $^{106}Ru-^{106}Rh$ chloride, pH 2, containing a combined activity of 9.5 μCi in a volume of 0.1 ml, was administered by stomach tube to nonfasted neonatal (6-day-old) and young adult (4-month-old) rats. They were sacrificed at 0.5, 1, 2, 6, 16, and 24 hr after administration of the isotope. The gastrointestinal tracts were excised intact frozen, and studied by autoradiography. Radioactivity in the various segments was also assayed using a single-channel γ scintillation spectrometer. Results of gastrointestinal passage times were expressed both as distance traveled and per cent of length traveled. A logarithmic model was developed to describe these data. When velocity was considered as centimeters traveled per unit time, particularly marked differences between the juvenile and adult were evident. In addition, bulk movement was described for each segment of the tract using ordinary linear regression techniques. The pattern and rates of passage in the neonatal rats differed from those in the adult reflecting physiologic and morphologic differences. (BBB)

50306 EFFECT OF ACTINOMYCIN D ON THE UPTAKE OF RADIOIODINE BY THYROIDAL AND EXTRATHYROIDAL TISSUES. I. **Shah, D. H.; Patel, M. C.; Sulakhe, P. V. (TATA Memorial Hospital, Bombay). Biochem. Pharmacol., 18: 1487-93(June 1969).**

Actinomycin D at a concentration of 15 μg/30 g mice markedly reduces the renal excretion and impairs the motility of stomach and thereby indirectly affects the iodide metabolism by sequestering a large amount of iodide in the stomach. It is possible that there is an enhancement of the uptake of radioiodine by the thyroid gland but it is evidenced only when the stomach releases iodine. (auth)

50307 CALCIUM UPTAKE IN MITOCHONDRIA AND VESICLES OF HEART AND SKELETAL MUSCLE IN PRESENCE OF POTASSIUM, SODIUM, k-STROPHANTHIN AND PENTOBARBITAL. **Dransfeld, H.; Greeff, K.; Schorn, A.; Ting, B. T. (Univ., Duesseldorf). Biochem. Pharmacol., 18: 1335-45 (June 1969).**

$^{45}Ca^{2+}$ uptake in mitochondria and vesicles of heart and skeletal muscle was measured in the presence of a low concentration of calcium. The following results were obtained. In mitochondria there was a rapid and brief Ca^{2+} uptake if succinate was present; when ATP was added, Ca^{2+} uptake was slow and prolonged; cyanide prevented the rapid Ca^{2+} accumulation and azide inhibited the slow Ca^{2+} uptake. In vesicles ATP was required for Ca^{2+} uptake and this was increased by oxalate, phosphate, or an ATP regenerating system. k-Strophanthin ($10^{-8}-10^{-4}$ M) had no significant effect on Ca^{2+} uptake in mitochondria or vesicles. Pentobarbital (1–6 mM) inhibited Ca^{2+} uptake in mitochondria of heart and white and red skeletal muscle but had no effect on Ca^{2+} uptake in vesicles. The $K^+:Na^+$ ratio in the incubation medium had an effect on Ca^{2+} uptake in mitochondria and vesicles of heart muscle and in mitochondria of red skeletal muscle. In mitochondria Ca^{2+} uptake was minimal at the $K^+:Na^+$ ratio of 1, and raising the $K^+:Na^+$ ratio up to 10 approximately doubled Ca^{2+} uptake. In vesicles the substitution of Na^+ for K^+ in the incubation medium diminished Ca^{2+} uptake, if Ca^{2+} uptake was not increased by oxalate, phosphate, or an ATP regenerating system. (auth)

50308 THE ABSORPTION OF BILIARY AND NONBILIARY RADIOCOPPER IN THE RAT. **Mistilis, S. P.; Farrer, P. A. (Univ. of Rochester, N. Y.). Scand. J. Gastroenterol., 3: 586-92 (1968).**

The extent to which biliary radiocopper is reabsorbed in the intestinal tract of the rat was defined, and results were compared with the absorption of radiocopper given in an ionic, chelated, and protein-bound form. Radiocopper (^{64}Cu) with initial activity of 0.5 to 2.5 μCi/μg was used, either as ionic cupric acetate or complexed with ethylenediaminetetraacetic acid (EDTA). In adult male Sprague–Dawley rats the radiocopper was given by an intrapyloric injection. Given as ionic ^{64}Cu or EDTA–^{64}Cu in a dose of 0.5 to 10 μg, 36% was absorbed. In a dose of 50 to 1000 μg, 10% was absorbed. Using biliary ^{64}Cu (from donor animals and collected in 3 fractions, namely 0-4, 4-8, and 8-24 hr) in a dose of 0.5 to 10 μg, 13% was absorbed. Less absorption occurred using later bile fractions. Absorption of 2.5 μg of the three fractions of dialyzed bile radiocopper was 15.5%, 12.3%, and 9.5%, respectively. Compared with ionic or EDTA–^{65}Cu, biliary ^{65}Cu was poorly absorbed. Parallelism was found between the dialysability of biliary radiocopper in the three fractions and the progressive lessening absorption. Malabsorption of biliary radiocopper is probably due to its presence in a bound form, possibly to protein. Similar degrees of malabsorption were also obtained with plasma radiocopper. (BBB)

50309 EFFECTS OF THE CARRIER COLLOID ON THE CLEARANCE AND DISTRIBUTION OF RADIOCOLLOIDS. **Anghileri, Leopoldo J. (The Johns Hopkins Medical Institutions, Baltimore). J. Nucl. Biol. Med., 12: 134-6(July-Sept. 1968).**

In rats, the effects of carrier colloids on the distribution of intravenously and intraperitoneally injected radiocolloids were studied. Arabic gum, when injected intravenously, reduced the liver uptake of the radiocolloid. Both gelatin and arabic gum, when injected intraperitoneally, increased the migration capability of the radiocolloids injected by the same method. (H.B.G.)

50310 THE DISTRIBUTION OF INHALED MERCURY ^{203}Hg VAPORS IN THE BRAIN OF RATS AND MICE. **Cassano, Giovanni B. (Univ., Pisa); Viola, Piero L.; Ghetti, Bernardino; Amaducci, Luigi. J. Neuropathol. Exp. Neurol., 28: 308-20(Apr. 1969).**

Mice and rats were exposed to ^{203}Hg vapor 6 hr daily for 10 days. The distribution of inhaled ^{203}Hg was studied up to 60 days later by microautoradiography and chemical analysis. Microautoradiography of brain sections of both mice and rats showed a greater concentration of radioactivity in the gray than in the white matter. The highest concentration of ^{203}Hg appeared in certain neurons of the cerebellum, spinal cord, medulla, pons, and midbrain. In the cerebellum, ^{203}Hg was selectively localized in the Purkinje cells, and in the neurons of the nucleus dentatus. Analysis of the different chemical fractions of the brain showed radioactivity in the

water-soluble fraction and in the insoluble tissue residue, and indicated that an equilibrium may exist between the radioactivity of these two fractions. The ^{203}Hg was found in free and bound fractions equally distributed in the brain. Later, radioactivity decreased in both fractions after a slight initial increase had occurred in the bound fraction. The anatomic localization of the histopathological changes caused by chronic Hg vapor intoxication seemed to correspond to the microautoradiographic distribution pattern of ^{203}Hg. (BBB)

50311 INDOLYL ACETIC ACID REACTIONS INDUCED IN PLANT TISSUES UNDER THE INFLUENCES OF HEAVY WATER. Dahlhelm, H.; Huebner, G. (Institut fuer Stabile Isotope, Leipzig). Wiss. Z. Univ. Rostock, Math.-Naturwiss. Reihe, 16: 527-8(1967). (In German).

Effects of various concentrations of D_2O on growth inhibition of sections of Avena, Triticum, Pisum, and Agrostemma were studied by measurements of mitotic activity and linear growth. Inhibitory effects were observed at D_2O concentrations as low as 30, and up to 99.8 at.%. In H_2O with natural isotopic composition, indolyl acetic acid (IES) increased tissue respiration by 15 to 20%. Tissue respiration was decreased by 20 to 35% in D_2O. This inhibition was not entirely prevented by addition of IES. Similar effects were obtained when indolyl acetyl asparaginic acid was substituted for the IES in D_2O solutions. Inhibition of respiration in D_2O solutions was less, as compared to the growth inhibition observed, which suggested that the effects were not entirely due to lack of energy sources, but may also be related to effects of D_2O on enzymatic reactions or on RNA synthesis. (BBB)

50312 GAS-CHROMATOGRAPHIC ANALYSIS OF RENAL FATTY ACIDS IN THE ALBINO RAT PANIRRADIATED WITH LETHAL AND NONLETHAL DOSES OF ROENTGEN RAYS. Slaviero, G. E.; Bobbio Pallavicini, E.; Ricotti, V. (Univ., Pavia, Italy). Arch. Sci. Med. , 125: 93-8(Mar. 1968). (In Italian).

The content of renal fatty acids was studied in albino rats subjected to x irradiation by means of gas chromatographic analysis of the methyl esters of total tissue fatty acids. In general there was a fall in oleic, linoleic, and linolenic acids and, less constantly, in arachidonic acid with opposite behavior in the percentage values of palmitic, stearic, and lignoceric acids. There was a consequent notable increase in the ratio saturated to unsaturated fatty acids, and this was greater the greater the radiation dose and after a certain amount of time had elapsed between the irradiation of the animal and its sacrifice. (auth)

50313 STUDIES ON THE BIOLOGICAL ACTION OF BENZPYRENE. III. LOCALIZATION OF TRITIATED BENZPYRENE IN THE RAT AFTER INTRAPERITONEAL ADMINISTRATION. Delwaide, Pierre A. (Univ., Liege). Biochem. Pharmacol., 18: 1275-83(June 1969). (In French).

The distribution of tritiated benz(a)pyrene in rat liver, kidney, adrenal, spleen, testicle, and heart was studied between ½ to 24 hr after intraperitoneal injection, with and without simultaneous administration of the large dose (20 mg/kg) of nonradioactive benz(a)pyrene. Intracellular distribution in the liver was similarly studied. In all cases, measurements were obtained of total radioactivity and of petroleum ether extractable radioactivity (corresponding to unmetabolized benz(a)pyrene). While tissue concentrations were maximal 4 to 6 hr after injection, no clear-cut organ specificity could be demonstrated either for levels of benz(a)pyrene or for the pattern of distribution between unchanged hydrocarbon and its metabolites. A small fraction (5%) of the initial dose was localized in the liver. In the subcellular fractions, microsomal localization was considerable at first; activity then increased steadily in the supernatant, where it was found in the form of non-extractable metabolites. (auth)

50314 THE TURNOVER OF ^{75}Se-SELENOMETHIONINE IN INFANTS AND RATS MEASURED IN A WHOLE-BODY COUNTER. Waterlow, J. C.; Garrow, J. S.; Millward, D. J. (Univ. of the West Indies, Kingston, Jamaica). Clin. Sci., 36: 489-504(June 1969).

Selenomethionine-^{75}Se was given to rats and to human infants, and the rate and route of excretion of ^{75}Se were followed for several weeks by daily measurements in a 4-pi whole-body counter. These data were used to calculate the turnover rate of total-body protein and the results were checked against other, technically more difficult, methods. The children were given 0.1 μCi ^{75}Se-methionine/Kg body weight. The radiation exposure produced by this dose is less than the dose given for diagnostic radiology, averaged over the entire population of the United States in 1964. An energy window of 0.1 to 0.3 MeV was used for counting since this was found empirically to provide the best count-to-background ratio. A sample of ^{75}Se as a point source at the center of the counter gave 170×10^3 cpm/μCi. The position of the child in the counter was critical, and this effect was found to be more serious for ^{75}Se than for ^{40}K. Successive counts on the same child differed by as much as 2%. In young rats the turnover rate of muscle protein calculated from radioisotope data agreed with estimates obtained by lysine infusion. However, in liver and serum protein selenomethionine was evidently recycled, and hence the apparent protein half-lives were improbably long. In children given ^{75}Se-selenomethionine intravenously the rate of loss of radioactivity, and the proportion excreted in the feces, was less than when it was given orally. The results in children differed from those in rats. Children reutilize the amino acid extensively whether or not dietary protein is limited, so a change in protein intake has little effect on the rate of excretion of isotope. The metabolic behavior of ^{75}Se-selenomethionine and ^{15}N-glycine was compared by giving both to a child simultaneously by intragastric drip, and by repeating the study at a different level of protein intake. It was concluded that the whole-body ^{75}Se-selenomethionine turnover is not a valid indicator of whole-body protein turnover, since selenomethionine is more reutilized than other amino acids, especially in the liver; and that isotope excreted by the two main routes, urine and feces, does not come from a single metabolic precursor pool. (BBB)

50315 STUDY ON THE REVELATION OF FERTILIZING EFFECT OF HUMIC ACID. 5. EFFECT OF NITROHUMIC ACID SODIUM ON ^{89}Sr ABSORPTION OF AQUATIC RICE ROOT. Aso, Sueo; Takenaga, Hiroshi (Tokyo Univ.). Nippon Dojo Hiryogaku Zasshi, 39: 558-64(Dec. 1968). (In Japanese).

Using three kinds of soil (Kashima and the experimental farm in Ibaraki prefecture, and Arakita in Tokyo metropolis) the influence of addition of Nitrohumic acid-Na (NHA-Na) into the rice field soil on the absorption of ^{89}Sr through the root of waterfield rice plant was studied. Following results were obtained. By the method of ion-exchange resins, Sr chelate action of NHA-Na was proved to be about 60 ~ 87 per cent of EDTA. The addition of NHA-Na caused to decrease the harvest in Kashima soil, but increased harvest in other soils. ^{89}Sr absorption quantity per unit dry weight of the waterfield rice plant decreased owing to NHA-Na. Some metallic ions of high chelate stability, such as iron and calcium, were thought to form the chelate compounds with NHA and to be absorbed preferentially. Absorbed ^{89}Sr was mainly stored in leaves. The distribution rate in lower leaves was high in the period of young ear formation and turnover to higher leaves was accelerated by NHA. As the result of the investigation of ^{89}Sr formation in the waterfield rice plant, the water soluble part in the ear of Kashima increased. The water soluble part and the acetic acid part in the leaves of Kashima and the experimental farm also increased. This is the reason of the increase of turnover. ^{89}Sr in the soil existed mainly as the substitution product and the combined amount with the water soluble part reached from 80 to 90 per cent of the whole ^{89}Sr. ^{89}Sr in the water soluble part existed as the anion product in extremely small quantity and its content was increased by NHA. (auth)

50316 ^{90}Sr AND CALCIUM CONTENT OF THE SKELETON OF MAN IN RELATION TO AGE. Pavlova, M. P.; Gurskaya, N. V.; Ternov, V. I. (Minsk Medical Inst. Belorussian Inst. of Sanitation and Hygiene, Minsk). Vestsi Akad. Navuk BSSR, Ser. Biyal. Navuk, No. 2, 125-7(1969). (In Russian).

The content of ^{90}Sr and calcium in the skeleton of man and its relation to age was determined. In children, the radioactivity in bones was higher than in adults. The content of calcium, on the contrary, increased with age. The radioactivity of the skull bones increased with age in proportion to the increase of their calcium content. (auth)

50317 ^{90}Sr AND CALCIUM CONTENT OF SKELETON DURING LEUKEMIA. Pavlova, M. P. (Minsk Medical Inst.). Vestsi Akad. Navuk BSSR, Ser. Biyal. Navuk, No. 2, 86-8(1969). (In Belorussian).

In the skeletons of humans who died of leukemia, especially children, an increased concentration of ^{90}Sr was found. Changes in the content of calcium in these skeletons were not found. (auth)

50318 INFLUENCE OF URANIUM-INDUCED RENAL INJURY ON FLOW AND COMPOSITION OF RENAL LYMPH. LeBrie, S. J. (Ohio State Univ., Columbus. Tulane Univ., New Orleans). Proc. Soc. Exp. Biol. Med., 131: 899-904(July 1969).

Uranium nephropathy resulted in a 3-fold increase in renal lymph flow as compared to the flow in control untreated dogs. Normal animals showed a significant 4.5-fold increase in lymph flow during mannitol loading while uranium-treated animals showed a significant 8-fold increase. The difference between groups (4.5 vs 8-fold change) was not significant, however. All animals with uranium nephropathy showed a significant proteinuria

at the time of the experiment as well as a significant reduction in lymph protein concentration. Prediuresis levels of urine flow were higher in untreated as compared to treated animals. Mannitol infusion was accompanied by an average increase in urine flow of about 20-fold in normal control animals. Animals with uranium nephropathy showed about a 5-fold increase in urine flow. These data appear to be consistent with the histological finding of primary damage to the distal segment of the proximal tubule resulting in leakage of fluid and electrolytes. This leakage of proximal tubular fluid results in a decrease in protein concentration of cortical interstitial fluid and an increase in interstitial volume. These are reflected as an increase in renal lymph flow and a decrease in lymph protein concentration. (auth)

50319 PHOSPHOGLUCOMUTASE ACTIVITY (RENAL, HEPATIC, AND BLOOD) IN RATS DURING EXPERIMENTAL POISONING WITH URANYL NITRATE. **Bastide, J.; Bastide, P. Rev. Fr. Etud. Clin. Biol., 13: 893-6(Nov. 1968). (In French).**

In 100 Sprague Dawley male rats, weighing 120 g, a tubulonephritis and an hepatitis were experimentally induced by an I. P. injection of 20 mg/kg of uranyl nitrate. In the sacrificed animals, 0, 24, 48, 72 and 96 hours after the injection, a very marked and continuous decrease in the renal phosphoglucomutase a clear-cut increase in the liver and plasma enzyme activity and a slighter increase in the erythrocyte phosphoglucomutase were noted. The contents of proteins, DNA, RNA as well as the hematocrits were determined. The results were analyzed and compared with the data of the literature quoted. (auth)

50320 FETAL RAT THYROID GLAND IN ORGAN CULTURE. **Nataf, B. M. (Institut Gustave Roussy, Villejuif, France). Gen. Comp. Endocrinol., 10: 159-73(Apr. 1968).**

The organ culture technique was used to study the action of thyrotropin (TSH) and of insulin on ^{131}I metabolism and on amino acid-^{14}C incorporation into protein in fetal rat thyroid glands. By addition of TSH to the culture medium, nonfunctioning fetal thyroid could be made to initiate radioiodine uptake in functioning fetal thyroid, TSH greatly improved ^{131}I utilization, reflected primarily in its increased incorporation of ^{131}I into thyroxine. Under similar conditions, TSH failed to influence the incorporation of ^{14}C-leucine into protein and puromycin, at a concentration that inhibited protein formation, failed to abolish the TSH-induced stimulation of ^{131}I incorporation into protein-bound iodotyrosines and thyroxine. Therefore, TSH stimulation of thyroid hormone production was not dependent on increased synthesis of protein. It is suggested that the effect of TSH on organ culture of embryonic thyroid glands is not dependent only on the stimulation of ^{131}I concentrating ability of the explants since TSH accelerates the conversion of monoiodotyrosine to diiodotyrosine and the formation of thyroid hormones. Insulin enhanced significantly the incorporation of ^{131}I into protein-bound iodotyrosines and thyroxine. (BBB)

50321 ACCUMULATION AND RETENTION OF INGESTED ^{106}Ru BY GENUINE GOBY. **Kimura, Kenichi; Ichikawa, Ryushi (National Inst. of Radiological Sciences, Chiba, Japan). Nippon Suisan Gakkaishi, 35: 434-40(May 1969).**

Accumulation and retention of ^{106}Ru by the goby, Acanthogobius flavimanus, were investigated for the case of ingestion of contaminated food. The average uptake of ^{106}Ru following single oral administration was observed as approximately 5% of the administered dose in either Ru/N or Ru/Cl form. The apparent equilibrium condition was reached about 12 days after beginning the experiment. The body burden at this state was about 20% of the average daily dose. The concentration factor for this fish over annelid worm was about 0.002 and hence, the transfer of ^{106}Ru through this kind of food chain was relatively small in comparison with the direct uptake from the surrounding seawater. (NSA of Japan)

50322 RENAL, HEPATIC, AND BLOOD XANTHINE OXIDASE ACTIVITY OF THE RAT IN EXPERIMENTAL URANYL NITRATE INTOXICATION. **Bastide, J.; Bastide, P. (Faculte Mixte de Medicine et de Pharmacie, Clermont-Ferrand, France). Clin. Chim. Acta., 25: 127-32(July 1969). (In French).**

Male Sprague–Dawley rats weighing 120 g were poisoned by a single intraperitoneal injection of uranyl nitrate (1 ml of a 2 g/l solution per 100 g body wt), and 24 to 96 hr later homogenates of various organs were prepared. Total protein, RNA, DNA, and xanthine oxidase activity were measured in these homogenates. A significant decrease occurred at 24 hr in renal xanthine oxidase followed by a marked rise at the 96th hr after the beginning of the U intoxication. A more clear-cut fall of the liver xanthine oxidase activity was as soon as the 24th hour, followed by slight reactivation and then by a continuous decrease until the 96th hr. Plasma xanthine oxidase activity rose, with a maximum at the 48th hr. The contents of protein, DNA, and RNA as well as the hematocrits are also reported. It is concluded that both the renal tubular and hepatic parenchymal cell lesions induced by U are accompanied by significant changes in oxido-reduction enzymes in these cells. (BBB)

50323 EFFECT OF GRADED LEVELS OF CADMIUM ON TISSUE UPTAKE OF ^{65}Zn BY THE CHICK OVER TIME. **Lease, J. G. (Montana State Univ., Bozeman). J. Nutr., 96: 294-302 (Nov. 1968).**

To ascertain if part of the interference of dietary Cd with the utilization of dietary Zn might be caused in part by competition for sites on a blood transport system, and to detect other early interference, chicks were fed graded levels of Cd with each of three levels of a single dose of ^{65}Zn. Uptake by the blood, liver, and tibiae was measured over a 24-hr period. Interference with uptake of 3 μg of ^{65}Zn was not found when zero, 5, 10, or 50 ions of Cd (mole equivalents) were included in the dose. When a basal dose of 18 or 27 μg of ^{65}Zn was fed, 5 or 10 molEq of Cd caused a marked decrease in absorption of ^{65}Zn. The difference in blood levels persisted over 24 hr, suggesting that Cd was occupying some of the blood-binding sites. The ^{65}Zn accumulated in the liver of the chicks fed Cd so that uptake did not differ from the basal group from 8 to 24 hr. The increase in liver uptake was not reflected in uptake by the tibiae, the latter being significantly lower than the basal group. It is postulated that Cd interferes with the absorption of Zn through occupation of some of the binding sites of a transport system in the blood; further interference with utilization of the absorbed Zn occurs at a more fundamental level. It is suggested that the effect of dietary Cd on dietary Zn will depend on the absolute amounts of each, the proportions of one to the other, and the length of the feeding period. (BBB)

50324 RENAL EXCRETORY MECHANISMS OF HEAVY METALS. I. TRANSTUBULAR TRANSPORT OF HEAVY METAL IONS IN THE AVIAN KIDNEY. **Vostal, J.; Heller, J. (Inst. of Industrial Hygiene and Occupational Diseases, Prague). Environ. Res., 2: 1-10(Sept. 1968).**

The urinary excretion patterns of ^{51}Cr, ^{52}Mn, ^{57}Co, ^{64}Cu, ^{99}Mo, ^{115}Cd, ^{203}Hg, and ^{212}Pb were studied, particularly the tubular transport of these ions in avian kidneys. The isotopes were all injected in doses of 100 μCi. Inulin, as a reference glomerular substance, was injected simultaneously with the radionuclide ions, or with Cd in the form of Cd cysteinate hydrochloride, into the renal portal circulation of the chicken. Radioactivity, independent of valence or positive or negative charge of the ions, was demonstrated in fractionated urine collections before the first detectable traces of inulin. All studied heavy metal ions were therefore considered to be similar to Na and other essential ions in being able to pass into the urine not only by glomerular filtration but also by direct transport across the tubular wall. The possible significance of this transtubular transport in the renal excretory mechanism of heavy metals, in relation to their plasma diffusible fractions, is briefly discussed. (BBB)

50325 STUDIES ON THE IODINE METABOLISM OF THE THYROID GLAND AS REVEALED BY ELECTRON MICROSCOPIC AUTORADIOGRAPHY WITH ^{125}I. **Fujita, Hisao (Hiroshima Univ.). Virchows Arch., B, 2: 265-79(1969).**

Distribution of radioiodine in the thyroid glands of adult mice and chick embryos was studied. In the mouse, silver grains appeared over the lumen of the thyroid follicle 3 min after intraperitoneal injection of ^{125}I and increased in number with time. No grains were detectable over most follicular cells of the mouse; occasionally a few grains were found over the cytoplasm, especially in the Golgi apparatus and apical cytoplasm of rare follicular cells, from 3 min to 24 hr after injection of ^{125}I. Thyroids of chick embryos 10, 13, and 18 days old, revealed several silver grains over the cytoplasm, especially in the Golgi apparatus, apical cytoplasm with small vesicles, rough endoplasmic reticulum, and the follicle lumen at 15 to 60 min after injection of ^{125}I. It was concluded that in the adult mouse iodination of the thyroglobulin takes place almost entirely in the follicular lumen and cell surface. In the chick embryo however, iodination in the thyroid cell may also occur. At 24 hr after injection of ^{125}I, the follicular lumen of the adult mouse showed numerous silver grains that appeared over large cytoplasmic droplets 1 to 2 hr after thyrotropin injection; these droplets may represent colloid reabsorbed from the follicle lumen. (BBB)

50326 AN ELECTRON-MICROSCOPE-AUTORADIOGRAPHIC INVESTIGATION OF THE LOCALIZATION OF ^{241}Pu IN RAT LIVER. **Rowden, G.; James, A. J. (Royal Free Hospital, London). Biochem. J., 3: 36P-7(Mar. 1969).**

The isotope ^{241}Pu is suitable for an electron-microscopic-autoradiographic approach to this problem, since the β-radiation emitted is of low mean energy, comparable with that of tritium. The resolution afforded by this isotope, which has a half-life of 14 years, allowed the storage sites in hepatic parenchymal cells

to be observed. At periods up to 4 days after intraperitoneal injection there was an increase in peribiliary dense bodies and approximately 70% of the developed silver grains were found in the vicinity of these organelles. The possible involvement of lysosomes and other components of the "vacuolar apparatus" with the heterophagy occurring with ^{241}Pu is discussed. (auth) (UK)

50327 ASSIMILATION AND BIOLOGICAL TURNOVER OF ^{134}Cs, ^{131}I, AND ^{51}Cr IN BROWN CRICKETS, ACHETA DOMESTICUS (L). Van Hook, Robert I. Jr.; Crossley, D. A. Jr. (Oak Ridge National Lab., Tenn.). Health Phys., 16: 463-7(Apr. 1969).

Understanding of radionuclide accumulation by insects requires careful assessment of assimilation and turnover rates. In separate experiments, three radionuclides (^{134}Cs, ^{131}I or ^{51}Cr) were fed to adult brown crickets for a 24-hr period. The insects were then transferred to nonradioactive food and their whole-body retention measured at 1-hr intervals. The retention of each radionuclide can be described by a sum of two exponential functions, a shorter one related to loss of unassimilated radionuclide from the gut and a longer one describing excretion of assimilated radionuclide from tissues. The shorter components had similar rates (half-time = about 4 hr) for all three radionuclides, indicating that they were a measure of gut clearance time. Chromium had the lowest assimilation (6%) and cesium the highest (65%). Assimilated ^{134}Cs and ^{51}Cr were eliminated at moderate rates (biological half-lives of 62 and 83 hr, respectively) but assimilated ^{131}I was stored rather than excreted. (auth) (UK)

50328 ^{137}Cs, ^{210}Pb, AND ^{210}Po CONCENTRATIONS IN SELECTED HUMAN TISSUES IN THE UNITED STATES. Baratta, Edmond J.; Apidianakis, John C.; Ferri, Esther S. (Dept. of Health, Education, and Welfare, Winchester, Mass.). Amer. Ind. Hyg. Ass. J., 30: 443-8(Sept.-Oct. 1969).

Radionuclide concentrations in selected human tissues in the Boston, Massachusetts area were studied. Since 1966, the study has concentrated on five selected tissues and was expanded to include other locations throughout the United States. The nuclides studied included ^{137}Cs, ^{210}Pb, and ^{210}Po. Tissue samples analyzed were lung, liver, heart, ileum, and bladder. For ^{137}Cs, the liver showed the highest concentration. The concentration for ^{210}Po was highest in the liver and lowest in the heart. The bladder had the highest concentration of ^{210}Pb, and the lung contained the least. Of the tissues tested, the $^{210}Po/^{210}Pb$ ratio for the liver and lung showed ratios consistently greater than one. The ratios for the other tissues were usually less than one. (auth)

50329 MATERIALY PO TOKSIKOLOGII RADIOAKTIVNYKH VESHCHESTV. VYPUSK 7. MARGANETS-54. (Reports on Toxicology of Radioactive Materials. Part 7. ^{54}Mn). Letaneta, A. A.; Burykinoi, L. H. (eds.). Moscow, Izdatel'stvo Meditsina, 1969. 168p.

Experimental data are given on the kinetics of metabolism and biological effects of small doses of ^{54}Mn chronically incorporated into rats. The absorption of the radioisotope from the intestinal tract, uptake by organs and tissues, and rate of excretion from the organism are discussed. The mean uptake of doses by tested animals was estimated. Biological effects of ^{54}Mn during daily uptake in drinking water (for 3, 6, 9, and 12 months) were compared with the effects of external γ-exposure at comparable doses (0.1 to 0.2 rad/day). Complex physiological, biochemical, hematological, immunological, hystological, and cytological data indicated high biological effects of ^{54}Mn and, also, its specific action. Mutagenic influence of ^{54}Mn observed at mean uptake dose of 40 rad revealed an increase of chromosome aberrations in the marrow cells and in the gonads of rats. Damaging effects of ^{54}Mn on the gonads and progenies born from exposed animals were confirmed. (168 references.) (R.V.J.)

50330 BIOLOGICAL HANDLING OF ^{75}Se-DISELENODIBUTYRIC ACID. Spencer, Richard P.; Brody, Kenneth R. (Yale Univ., New Haven). J. Nucl. Med., 9: 621-3(Dec. 1968).

Radiolabeled ^{75}Se-diselenodibutyric acid was synthesized and the uptake by various tissues was studied in dogs, hamsters, mice, and rats using various methods of administration. It was rapidly absorbed from the small gut of the dog and rodents in vivo. However, the compound did not undergo net transport across the gut wall in vitro when the concentration was initially the same on both sides. There was an accumulation within the gut wall. When given intravenously, the radiolabel rapidly appeared in the urine (about one-half was excreted in 1 day in the dog, and approximately 90% was eliminated by 1 week). In addition to renal localization, the compound showed considerable hepatic uptake. These findings partially resemble the distribution of chlormerodrin and suggest binding to sulfhydryl groups. Initial plasma radioactivity was largely precipitated by trichloracetic acid, indicating protein binding. However, a major portion of the initial protein-bound radiolabel was freed by treatment with sodium bisulfite, suggesting that much of the binding was of the form —Se—S—. After several days, remaining plasma radioactivity that precipitated with trichloracetic acid did not solubilize when shaken with sodium bisulfite. Selenium-75-labeled diselenodibutyric acid, in addition to its possible use in following renal and hepatic binding and possible sulfide-selenide interchange, forms the starting point for the synthesis of a series of monoselenofatty acids. (C.H.)

Radiation Effects

Refer also to abstracts 49816, 49822, 50445, 50639, 50817, 50830, 50832, 50874, 50884, 50920, 50964, and 50976.

50331 (AI-AEC-Memo-12861) RADIATION CHEMISTRY OF CHROMOSOMES, DECEMBER 1966 TO JUNE 30, 1969. Holroyd, R. A.; Sevilla, M. D. (Atomics International, Canoga Park, Calif.). June 27, 1969. Contract AT(04-3)-701. 451p. Dep. CFSTI.

Chromosomes and chromosome constituents were exposed to electrons and hydrogen atoms, which are intermediates expected to be produced by ionizing radiation. The reactions of hydrogen atoms with purines and pyrimidines were studied and characteristic ESR spectra were obtained for each base. It was then possible to study the reactions of hydrogen atoms with DNA. It was found that hydrogen atoms react non-specifically by addition to the bases in DNA. The presence of histones was found to inhibit hydrogen atom attack on the DNA and result in preferential formation of radicals in the histone component. A tritium labeling technique was used to identify the radical sites on various amino acids of the histone samples. A high degree of specificity was found in that 67% of the radicals formed were on lysine residues. It was found that electrons reacted readily with adenine, cytosine, thymine, and uracil to form anions; but only the thymine anion reacted further by protonation. Interpretation of the ESR spectrum showed that protonation occurs at the 6-position of thymine. Thus the same radical is formed by electrons as is observed in the radiolysis of DNA. The reaction of electrons with amino acids was shown to be dependent on the nature of the substituent side groups. For glycine and amino acids with alkyl side groups the anion formed preferentially deaminates to form a carbon radical. For amino acids containing disulfide linkages electron attachment to the —S—S-group occurs. For methionine, which contains a R—S—CH_3 group, electron attachment to the sulfur results in cleavage of a S—C bond and CH_3 radicals are formed. Many of the radicals observed in this study have also been observed in ESR studies of irradiated amino acids and the role of electrons in radiolysis has thereby been clarified. Current work with dipeptides suggests that electrons preferentially deaminate terminal amino groups. In a chromosome there are many sites of electron attachment but charge migration within DNA and histone molecules may occur. If this is the case then on the basis of our results we would postulate that electrons would remove terminal α-amino groups on histones and form free radicals on thymine base groups in DNA. (auth)

50332 (COO-1747-2) X-RAY INDUCED SYNTHESIS OF DNA IN POLYTENE CHROMOSOMES. Technical Progress Report. Plaut, W. (Wisconsin Univ., Madison. Dept. of Zoology). Aug. 1969. Contract AT(11-1)-1747. 9p. Dep. CFSTI.

Tests were made on freshly excised glands where DNA and RNA synthesis had been inhibited (by pretreatment with 10^{-6}M FUdr and 5 μg/ml of Actinomycin D or with a 10^{-3}M soln. of hydroxyurea and 5 μg/ml of Actinomycin D), on glands transplanted and cultured in the abdominal cavity of adult flies (such glands show little or no thymidine incorporation after 8 days of implantation), and on glands from 1 (2) gl, where thymidine incorporation is restricted to 10% or less of the nuclei. The two lobes from each gland were separated, one was used for treatment and the other as control, 30,000 R of x rays was the usual dose of irradiation; the glands were subsequently incubated with tritiated thymidine and studied autoradiographically. The results obtained show that x rays induce thymidine incorporation in salivary gland chromosomes which appears to be related to the repair synthesis observed in other cell types. In contrast to normal replicative synthesis, the sites of incorporation are randomly distributed and fewer grains are observed over the chromocentral region. Moreover, labeling never extends across the entire chromosome at any one point, suggesting the involvement of less than all the DNA helices at any one site. These differences as well as the fact that the induced synthesis is observable in nuclei which no longer replicate DNA and in nuclei where normal DNA and RNA syntheses have been inhibited suggest that this presumptive repair synthesis is a separate process from normal chromosomal DNA replication. (auth)

50333 (YALE-2653-34) PROGRESS REPORT, AUGUST 1, 1968-JULY 31, 1969. Hutchinson, Franklin (Yale Univ., New Haven, Conn. Dept. of Molecular Biophysics and Biochemistry). Contract AT(30-1)-2653. 9p. Dep. CFSTI.

Studies on the effects of ionizing radiation on Bacillus subtilis resulted in the production of double-strand breaks in DNA at the rate of one break per 4 kilorads. If the bacteria were incubated in growth medium for 100 minutes after irradiation, approximately 2 out of 3 of the double-stranded breaks were repaired. DNA containing bromouracil was treated with vinyl acetate and exposed to 3100 angstroms of UV light for electron microscope examination. Studies were conducted on linkage of genetic markers on a single large molecule of B. subtilis DNA. Studies on the circular dichroism of BU-DNA showed that the substitution of bromouracil for thymine produced a marked change in the spectrum. Uptake of circular DNA in B. subtilis cells was measured for bacterial transformation studies. Experiments on the effect of single-strand breaks on transforming activity showed that the ability of the DNA to be integrated into the recipient cell genome depends only on the single strand length present in the cell, and it is independent of whether the length of the strand is determined by single strand breaks or by the double-strand breaks which determine the overall length of the DNA molecule. The second conclusion is that if transforming DNA is irradiated in dilute solution, the loss of transforming activity is determined quantitatively by the single strand breaks produced. (H.L.W.)

50334 DNA REPAIR MECHANISMS AND THEIR RELATION TO MUTATION AND RECOMBINATION. Strauss, Bernard S. (Univ. of Chicago). Curr. Top. Microbiol. Immunol., 44: 1-85 (1968).

The nature of the lesions produced in DNA by uv and x rays, ^{32}P decay, acridine orange photosensitization, and thymine starvation, as well as their repair, is reviewed. The types of damage that may be produced by x rays can be classified as: direct damage resulting in single- and double-strand breaks (rare); indirect damage mediated by free radicals which are quenched by histidine or SH-containing compounds and which results in single- and double-strand breaks; and indirect damage mediated by a different class of free radicals which results in chemical changes in the pyrimidine bases. The inactivation of DNA from decay of incorporated ^{32}P is probably due to the scission of the molecule by double-strand breaks. The structure of DNA after x-ray-induced breakage is not known since the chemical structure of those free radicals that frequently cause the breakage cannot be specified, and the same ambiguity exists in the chemical effect of ^{32}P decay. Mechanisms to account for the phenomenon of dark repair of uv-induced damage that were proposed are discussed. The most general hypothesis presumes the following steps to occur: recognition of pyrimidine dimers by an endonucleolytic enzyme system that breaks the affected DNA chain at or near the site of the dimers; removal of damaged bases along with an unspecified contiguous portion of the same strand of DNA (the excision step); restitution of the removed portion by a polymerase type enzyme using the remaining undamaged strand as a template for the enzyme action. The evidence for this error correcting mechanism of repair from uv damage is set forth. The idea that more than one process functions to repair DNA is implicit in much of the work described in this review. Different enzymes must be involved in the initial stages of repair from different types of damage. Mutants unable to excise pyrimidine dimers may be more efficient in recombination as measured by either transduction or transformation. The participitation of DNA in repair mechanisms is clear but in no case has the detailed enzymatic mechanism been determined and reconstructed in vitro. The most pressing need is an enzymatic analysis of the phenomena encountered and an in vitro system that really duplicates the in vivo properties of the dark-repair system. (BBB)

50335 GERMINATION-INDUCED REPAIR OF SINGLE-STRAND BREAKS OF DNA IN IRRADIATED BACILLUS SUBTILIS SPORES. Terano, Hiroshi (Kyoto Univ.); Tanooka, Hiroshi; Kadota, Hajime. Biochem. Biophys. Res. Commun., 37: 66-71 (Sept. 24, 1969).

The single-strand breaks produced in DNA of Bacillus subtilis spores by ionizing radiation were repaired during germination in the absence of normal DNA synthesis. This repair did not occur unless the initial stage of germination was induced. (auth)

50336 THE SHIFTS OF ELECTROLYTES AND RADIOACTIVE IONS IN THE MYOCARDIUM DURING VARIOUS CARDIOTOXIC INTERVENTIONS AND ADMINISTRATION OF SOME POTASSIUM AND MAGNESIUM SALTS. Vasku, Jaromir; Urbanek, Erich; Praslicka, Milan; Bednarik, Bohumil (Purkyne Univ., Brno). Arzneim.-Forsch., 19: 704-8(May 1969).

Shifts in the composition of myocardial ions, nonradioactive and radioactive, were studied during electrolyte and steroid cardiopathy with necrosis (ESCN) and during this cardiotoxic treatment after previous ^{60}Co γ irradiation. The effect of administration of monopotassium-D,L- and monomagnesium-D,L-aspartate on the composition of the ions in the myocardial tissue in a group with cardiac necrosis only, and in continuously irradiated animals with subsequent cardiotoxic treatment was also studied. Irradiated animals were treated continuously in a ^{60}Co γ field for 12 days, with 90 R daily. Daily irradiation time lasted 23 hr, and total dose of irradiation within 12 days was 1080 R. Continuous irradiation combined with cardionecrotic treatment by the administration of Na_2HPO_4 and fluorcortisol induced ion shifts in the myocardium, which were different from the changes observed after cardiotoxic administration of Na_2HPO_4 and fluorcortisol only. The intracellular level of K, Na, and Ca was increased. Administration of K-Mg-aspartate increased still more the level of K, but Ca and Na were depressed. The K-Mg-aspartate thus inhibited this ion shift in the irradiated myocardium. Retention of ^{42}K in various cardiotoxic conditions in the heart muscle tissue seemed to depend largely upon the content of nonradioactive Ca in the heart tissue, irrespective of the content of nonradioactive K and Na in the heart, because the shifts of the nonradioactive and radioactive K ions were often opposite. The intracellular storage of the radiosodium in the first cardionecrotic group was greatly increased, the same increase of ^{24}Na being observed also in the fourth group, the animals of which were treated at first by continuous irradiation, then by the administration of cardiotoxic substances, and later by the cardioprotective treatment with K-Mg-aspartate. (BBB)

50337 EFFECT OF UV-LIGHT ON THE LIPOQUINONE AND PIGMENT COMPOSITION OF ISOLATED SPINACH CHLOROPLASTS. Lichtenthaler, Hartmut K.; Tevini, Manfred (Univ., Muenster, Ger.). Z. Naturforsch., 24b: 764-9(June 1969). (In German).

The changes in quinone and pigment composition of isolated spinach chloroplasts were investigated after treatment with uv-light of 254 mμ, that is known to decrease the Hill-reaction activity. The plastidquinones are more uv-sensitive than carotenoids (except neoxanthin) and chlorophylls. Neoxanthin, reduced plastoquinone 45 and α-tocopherol function consecutively as lipid antioxidants and are first destroyed. The latter are oxidized to the corresponding quinones plastoquinone 45 and α-tocoquinone, which thus seem to be less uv-sensitive. The decrease of the Hill-reaction activity runs parallel with the decomposition of plastoquinol (= Plastohydrochinon) and not with that of plastoquinone as has been assumed so far. This indicates that plastoquinol is needed for performance of the Hill-reaction. The naphthoquinone vitamin K_1, bound to the pigment system I of photosynthesis, is less uv-sensitive than the plastidquinones of the benzoquinone type which are associated mainly with the pigment system II. The possible function of vitamin K_1 as one natural cofactor of cyclic photophosphorylation is discussed. (auth)

50338 EXPERIMENTAL CONTRIBUTION TO FAT EMBOLISM AND RADIATION SICKNESS. Kroupa, J. (Research Inst. for Traumatology, Brno). Klin. Med. (Vienna), 22: 142-4(1967). (In German).

Effects of irradiation of guinea pigs with x-ray doses of 300 to 800 R were studied. Survival rates after 2 weeks for animals that received 300, 600, and 800 R were 60, 10, and 0%. Values for total protein, lipids cholesterol, phospholipids, inorganic P, K, Na, and Ca, ceruloplasmin, aldolase, transaminases, lactic dehydrogenase, tributyrinase, and leucocyte counts were evaluated in the irradiated animals. Ceruloplasmin, inorganic P, and phospholipids decreased slightly. The leucocyte counts decreased in proportion to the irradiation dose given, and continued to decrease until the animals' death. When the rear legs of the animals were fractured 12 or more hr after irradiation, the values of the various factors varied considerably, but no effects were observed if their legs were fractured at the time of irradiation. In the lungs of the irradiated animals the vascular permeability of the parenchyma was altered. After irradiation doses of 600 or 800 R hyaline membrane protein and numerous erythrocytes were lost. Vascular effects were most pronounced in irradiated animals with fractured legs. Fatty material appeared in the lung alveoli after irradiation doses of 800 R. Other effects of irradiation were observed in bronchial mucosa, blood vessels, lymphatic tissue, kidneys, and brain. (BBB)

50339 PHOTOSENSITIZED DIMERIZATION OF THYMINE AND CYTOSINE IN DNA. Ben-Ishai, R.; Ben-Hur, E.; Hornfeld, Y. (Technion-Israel Inst. of Tech., Haifa). Israel J. Chem., 6: 769-75(Sept.-Oct. 1968).

Acid hydrolysates of ^3H-thymine-labeled DNA and ^3H-cytosine-labeled DNA irradiated at >300 mμ for 15 hr in the presence of 1M acetone contain two ^3H-thymine derived and two ^3H-cytosine derived photoproducts. The chromatographic mobilities of these photoproducts were similar to those of the pyrimidine dimers TT, UT and UU (T = thymine, U = uridine). Photomonomerization results strongly suggest that in the presence of acetone as a photosensitizer the photoproducts formed in DNA are identical with the thymine and cytosine (C) homo- and heterodimers. The photosen-

sitized dimerization of TT and CT as a function of dose was studied. The thymine homodimer was produced at a higher rate than the heterodimer. At high doses 37 and 3.2% of the thymines in DNA could be converted to TT and CT. Taking into account the frequencies of the nearest neighbor base sequences in Escherichia coli DNA, 58% of the TT and 7.2% of the CT + TC dinucleotide sequences were dimerized. In E. coli DNA, irradiated with large doses of uv light (254 mμ) only 10.5% of TT and 1.9% of the CT + TC nearest neighbor sequences were dimerized. The increased dimer formation in the presence of a photosensitizer may be attributed to the irreversibility of the photodimerization reaction at the wavelength of irradiation. Similar experiments with 0.02M acetophenone suggested that CC dimer formation in DNA cannot be sensitized by acetophenone. In the presence of acetone, triplet → triplet energy transfer from the photosensitizer to both thymine and cytosine in DNA may occur. In acetophenone, the absence of CC dimerization and the decreased rate of CT formation suggest that only the thymine triplet in DNA is populated. (BBB)

50340 MECHANISMS OF ENHANCEMENT OF SP82 TRANSFECTION. Epstein, H. T.; Mahler, Inga (Brandeis Univ., Waltham, Mass.). J. Virol., 2: 710-15(July 1968).

SP82 transfection in Bacillus subtilis could be markedly increased by exposing the competent cells to ultraviolet (uv)-irradiated homologous or heterologous cellular deoxyribonucleic acid (DNA). This enhancement was similar in time and level of peak effect to enhancements effected by preinfection with helper phages or by uv irradiation of competent cells. The effectiveness of various DNA preparations in increasing transfection paralleled the adenine plus thymidine content of the preparations and was maximal at uv doses approaching those that were maximal for pyrimidine dimerization. The most probable interpretation is that irradiated DNA binds cellular nucleases that would otherwise inactivate the incoming transfecting DNA. (auth)

50341 PHYSICOCHEMICAL BASES OF THE EFFECT OF LIGHT ON THE SKIN. Ippen, H. (Univ., Duesseldorf). Fette-Seifen-Anstrichm., 70: 669-72(Sept. 1968). (In German).

Effects of uv irradiation (2537 Å) on nucleic acids of the skin cells were discussed. It was concluded that the primary effect probably was the dimerization of thymine in the DNA of the prickle cell nuclei, while the similar effects produced on uracil of the RNA were not important. As a result of this type of primary effect there was disturbed catabolism of the DNA chain that produced the skin effects observed. The dimerization effects produced by uv light were illustrated by structural formulae, and the photodimers produced were indicated. The structural preconditions for photodimerization of the DNA components were shown by comparison of various chemical groups that favored the photodimerization reaction. (BBB)

50342 NEOGENESIS OF DNA AND THE DEVELOPMENT OF MALFORMATIONS FOLLOWING WHOLE-BODY X IRRADIATION OF EARLY EMBRYONIC PRIMORDIA OF RATS. (RADIOAUTOGRAPHIC STUDIES). Wegner, G.; Haas, R. (Univ., Freiburg i. B.). Verh. Deut. Ges. Pathol., 51: 282-7(1967). (In German).

Effects of single whole-body x-irradiation doses of 150 R on embryonic cells of rats were studied by means of ^{3}H-autoradiography and ^{14}C-thymidine injection. Numerous pyknoses were observed in the blastoderm within two to five hr after irradiation. The mitotic frequency also fell from a normal value of 4.8 to a value of 1%. The mitoses observed were pyknotic. The ^{3}H labeling index was almost nil. During the 24 to 48 hr interval after irradiation the degrees of labeling of the cardiac and intestinal primordia were almost the same as in normals, and in the brain primordia exceeded normal after 24 hr. Closure defects were observed in the cranial neural crests 24 hr after irradiation. There was a considerable decrease in the ^{3}H labeling index of the matrix cell residues of malformed animals three days after irradiation. The decrease in ^{3}H index was from 20 to 40% in the irradiated animals in the brain primordia, and between 12 and 25% in the cardiac primordia. Late changes included decreased numbers and irregular arrangements of DNA-synthesizing cells, considerably diminished matrix cell layers, and cerebral pyknoses. Malformations observed nine days after irradiation included anencephalus, microencephalus, hydrocephalus, cerebral hernias and schistasis, cardiac ectopy, ventricular septum defects, liver and intestinal ectopy, skeletal fissures, palato-gnatochises, and ventral closure defects of the thorax. (BBB)

50343 INDUCTION AND REJOINING OF BREAKS IN THE DEOXYRIBONUCLEIC ACID OF HUMAN CELLS IRRADIATED AT VARIOUS PHASES OF THE CELL CYCLE. Lohman, P. H. M. (Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek, Rijswijk). Mutat. Res., 6: 449-58(Nov.-Dec. 1968).

The induction and rejoining of single-strand breaks in the DNA of asynchronous and synchronized cultures of human-kidney cells (T-cells) were investigated. The assessment of breaks was carried out with a modified alkaline sucrose-gradient technique. The cells were lysed on top of the gradient in the presence of triisopropylnaphthalenesulphonic acid (TIPNS) and 4-aminosalicylic acid (PAS). The sedimentation pattern of DNA was studied after x irradiation with doses up to 40 krad. Breaks could be detected by irradiating cells with doses higher than 5 krad. With synchronous cell populations the smallest induction of breaks was found in the DNA of cells in progress from late S to early G_2. More breaks were induced in early S and G_1. The rejoining of breaks in the DNA was studied during incubation of the cells at 37° after x ray exposures to 5 and 20 krad. The capacity of rejoining breaks seemed to fluctuate slightly in the different phases of the cell cycle, being most effective in early S and minimal in G_2 phase. In preliminary experiments, carried out to study the influence of protective agents, it was found that the presence of cysteamine during irradiation protected against radiation-induced breaks. (auth)

50344 INFLUENCE OF ULTRASONIC RADIATION IN THE MEDICAL THERAPEUTIC RANGE ON THE FINE STRUCTURE OF THE LIVER PARENCHYMAL CELL. AN ELECTRON MICROSCOPE STUDY ON MICE. Valtonen, Erkki J. (Univ. Central Hospital, Helsinki). Arch. Pathol. Anat., 343: 26-33(Oct. 30, 1967).

A megason XII device emitting a frequency of 1 Mcps at an intensity from 0.5 to 3 W/cm^2 was applied to the upper abdomen of unanaesthetized mice and specimens of the liver were examined with the electron microscope. The appearance of the fine structure of the liver cells ranged from nearly normal (intensity of 1 W/cm^2 for 1 min) to complete loss (coagulation) of the fine structure of the cell organelles (intensity of 3 W/cm^2 for 3 min). In addition, cavitation and disruption of the cytoplasm occurred in the hepatic cells. The changes were probably due to both the thermal and mechanical effects of the ultrasound, and the relative anoxia may play some role in causing the formation of intracellular vacuoles. (BBB)

50345 EFFECT OF LASER RADIATION ON MITOSIS. Okigaki, Tohru; Rounds, Donald E. (Pasadena Foundation for Medical Research, Calif.). Chromosome Inform. Serv., No. 8, 16-19(Dec. 1967).

The effect of laser radiation on mitotic activity was examined in cultured cells of adult salamander lung tissue at prophase and metaphase irradiated with a focused ruby laser beam. Treated cells were photographed with the aid of phase contrast optics before and after irradiation. The photograph of mitotic cells irradiated at metaphase showed no appearance of nuclear or cytoplasmic division and showed the formation of a new nuclear membrane. From the photograph of mitotic deformation after laser irradiation at metaphase, it appeared that chromosomes started to separate into two poles but later stopped completely, and finally, diffused into filamentary structures within the space surrounded by the newly formed membrane. Whether these irregular phenomena were caused by the high temperature or the intense light of the laser flash was not determined. (NSA of Japan)

50346 ADDITIONAL IMMUNOLOGICAL AND RADIOHEMATOLOGICAL STUDIES WITH PENTOSANPOLYSULFOESTER (SP^{54}) BEFORE AND AFTER IRRADIATION WITH 120, 600, AND 1200 R GAMMA RAYS. Sachs, V.; Szirmai, E.; Betsch, J.; Knapp, J.; Keinert, J.; Hehn, G.; Berthothy, L. (Univ., Kiel). Haematologica (Pavia), 53: 627-36(1968). (In German).

Effects on blood clotting time of γ irradiated pentosanpolysulfoester (SP^{54}) after doses of 120, 600, or 1200 R were reported. Addition of SP^{54} irradiated with 600 or 1200 R to blood prolonged clotting times. There were no statistically significant differences in clotting times between blood irradiated with 120 and 600 R or 600 and 1200 R, but the differences between clotting times between 120 and 1200 R were significant. These results indicated that there was an exponential relation between irradiation dose and clotting time. Pherograms of the irradiated SP^{54} were illustrated. Compared to controls, the weak lines that represented the γ and β range became weaker and less prominent as the irradiation dose was increased. (BBB)

50347 EFFECTS OF X IRRADIATION ON THE SKIN. I. HISTOCHEMISTRY OF ACUTE CHANGES IN THE EPITHELIAL STRUCTURES. Kurban, Amal K.; Farah, Faud S. (American Univ., Beirut). Acta Dermato-Venereol., 49: 64-71(1969).

The histological and histochemical changes induced in the epithelial structures of the skin following x irradiation were studied in guinea pigs. A single 4000 R dose of 50 kV x rays was given. Biopsy specimens were removed from irradiated skin sites and from comparable areas of the skin of control animals at 3-hr intervals for the first 24 hr and then every 24 hr for 3 to 4 weeks. The epidermal basal cell layer and the matrix of the hair follicles showed the earliest degenerative changes. Both DNA and RNA structures in the epithelial cells showed disturbances, but the

changes were more apparent with DNA. Even though there was an early effect on the quantity of reactive SH groups in the epidermis, the ultimate effect on the epidermal function was the formation of keratin that seemed to differ chemically from the normal. Different enzyme systems responded differently to irradiation. In particular, the activities of β-glucuronidase and most of the dehydrogenases in epithelial cells showed an early marked decrease. Alkaline phosphatase activity in the sebaceous gland showed an initial increase and then decrease. (BBB)

50348 EFFECTS OF X IRRADIATION ON THE DNA AND RIBONUCLEASE LEVELS OF GUINEA-PIG (CAVIA PORCELLUS) SMALL INTESTINE. Gresham, P. A. (Univ. of Birmingham, Eng.). Comp. Biochem. Physiol., 29: 455-9(Apr. 1969).

Little visible damage to the epithelium of guinea pig small intestine occurs during the first day after whole-body exposure to x irradiation up to 2000 R, although the $LD_{50/30}$ for guinea pigs is only 350 to 400 R. Rats in contrast, show marked histological damage to the intestinal epithelium after only 600 R. Changes in guinea pig intestinal homogenate were studied to determine whether the comparative lack of morphological damage was also associated with smaller changes in DNA and ribonuclease levels than occurred in rat. The total protein content of the total intestinal homogenate, DNA/protein ratio, enzyme activities, and ratio of free to total acid RNAase levels were not significantly altered 18 hr after 1000 R or 2000 R, except for a 35% increase in the level of alkaline RNAase activity relative to protein after 2000 R. The lack of change in total protein and in DNA/protein ratio means that this 35% increase also represents the change in total homogenate content and average cellular content of the enzyme. In rat intestine the phosphodiesterase level dropped by 33% at 18 hr after 700 R whole-body irradiation or local irradiation of the trunk. This enzyme is localized in the brush-border membrane of intestinal epithelial cells, which show visible damage after whole-body irradiation, and may disappear from the surface of the epithelial cells. The alkaline RNAase level in rat intestine was increased by 50% relative to protein and nearly 200% relative to DNA after only 700 R. Thus biochemical and morphologic changes in intestine can be correlated. (BBB)

50349 DYNAMICS OF REGENERATION OF THE BODY AFTER IRRADIATION. I. CHANGES IN THE MITOTIC INDEX OF THE FEMORAL BONE MARROW IN RATS IRRADIATED WITH A SINGLE AND FRACTIONAL DOSE OF 1000 R. Izvoranu, M.; Cilievici, Olga; Oprisan, Ana (IMF, Bucharest). Fiziol. Norm. Patol. (Bucharest), 14: 531-7(Nov.-Dec. 1968). (In Rumanian).

Investigations were carried out on the mitotic indices of the femoral marrow following irradiation with a lethal dose of 1000 R. The experiments were carried out on white Wistar male rats, separated into three groups: a control group (hepatectomized and non-irradiated rats), a group irradiated with a single 1000 R dose (hepatectomized and intact rats) and a group irradiated with a total 1000 R dose, administered in three 335 R doses at 48 hours intervals (hepatectomized and intact rats). A decrease of 50/80% of the mitotic index was found in the femoral marrow cells of the rats exposed to a single 1000 R dose. In exposure to a single dose, the destruction was greater than in fractional irradiation, being 80% as compared to the normal, and only 50% in the latter case. Hepatectomy stimulates mitosis in the hematopoietic organs of the irradiated animals. (auth)

50350 ESTERASES OF THE PANCREAS AND DUODENUM OF RATS UNDER THE ACTION OF X-RAYS AND THIOPHOSPHAMIDE. Levitskii, A. P.; Lozitskii, V. P. (Medical Inst., Odessa). Radiobiologiya, 9: 313-15(1969). (In Russian).

It was shown that x irradiation induced a decrease in the activity of lipase, carboxylesterase, and arylesterase of the duodenum and pancreas in rats, that was most pronounced on the third day. Thiophosphamide produced a similar decrease in the esterase activity beginning with the third day after administration, while the activity of the pancreatic lipase did not decrease in all periods of investigation. (auth)

50351 X-RAY-INDUCED ALTERATIONS IN THE MITOTIC CYCLE. Varga, L.; Varteresz, V. (Frederic Joliot-Curie National Research Inst., Budapest). Acta Biochim. Biophys. (Budapest)., 4: 79-87(1969).

Labeling studies with ^{3}H-thymidine were used to study phases of the mitotic cycle in mouse NK lymphoma cells as affected by x irradiation. The tumor cells were inoculated intraperitoneally in mice, and on the 6th day after inoculation each animal was injected intraperitoneally with 10 μCi of ^{3}H-thymidine. They were given whole-body irradiation with 10, 50, 100, 250, and 500 R 30 to 60 min later. By the 5th hr postirradiation the level of labeled cells amounted to 75%, by the 6th hr to the maximum, i.e., to 90%. This level remained unchanged up to the 15th hour. From that time on the labeled mitosis curve showed a slow decline, and reached its minimum between the 25th and 26th hr. At 27 to 28 hr the labeled cells entered the M stage again, and the curve showed an ascending tendency. Durations of various parts of the mitotic cycle were seven to eight hr for G_1, 10.6 hr for S, 4.4 hr for G_2, and 22 to 23 hr for the entire mitotic cycle in nonirradiated controls. Mitotic inhibition developed in the irradiated groups, lasting longer the higher dose used (after 10 R = 5.6 hr, 500 R = 10.4 hr). The cells displayed increased mitotic activity after the release of mitotic inhibition, and in the first postirradiation cycle the reproduction rate of the population was higher than that of the controls. The mitotic overshoot was interpreted as being a result of the shortening of G_1 and S phases and of the accumulation of cells before the G_2 block. (BBB)

50352 MECHANISM OF METHEMOGLOBIN FORMATION. Gromov, A. E.; Sokolovskii, V. V. Biochemistry (USSR) (Engl. Transl.), 33: 792-5(Sept.-Oct. 1968).

Translated from Biokhimiya, 33: 976-80(Sept.-Oct. 1968).

Exposure of hemoglobin in the presence of oxygen to ultraviolet (uv) radiation, heat, and various chemicals caused the formation of methemoglobin. Apparently the globin lost the ability to prevent oxidation of heme. These changes appeared to be inseparably linked to a change in the native conformation of the protein portion of the hemoglobin molecule. (M.M.B.)

50353 ACTION OF GLYOXAL, PRODUCT OF RADIOLYSIS OF SUGAR, ON PLANT TISSUES CULTIVATED IN VITRO. Manant, Pierre; Schaeverbeke, Janine; Jonard, Robert (CNRS, Paris). Compt. Rend., Ser. D, 268: 2414-16(May 19, 1969). (In French).

Glyoxal, which is one of the products formed in the course of radiolysis of sugar, manifests the same toxic effect as irradiated sugar on tissues of the Jerusalem artichoke and the crown gall of Scorzonera cultivated in vitro. It stimulates in the same way the new formation and elongation of roots in artichoke tissues. One can then attribute to the presence of glyoxal the properties that the irradiated sugar manifests in regard to plant tissues cultivated in vitro. (tr-auth)

50354 EVALUATION OF GLUTAMIC-OXALOACETIC TRANSAMINASE IN IRRADIATED ANIMALS. Rodriguez, Eduardo Ramos. Acta Iber. Radiol.-Cancerol., 22: 253-68 (July-Sept. 1967). (In Spanish).

Glutamic-oxaloacetic transaminase (G.O.T.) is an intracellular enzyme whose presence in the blood of guinea pigs has a low and almost constant level. The irradiation of these animals with low and intermediate doses from Van de Graaff generators produces an increase of this level in about 75% of the animals, occasionally by more than five times. The technique used for the evaluation of the G.O.T. level in the blood of the irradiated animals was the same as is used clinically. It is an easy procedure and the reading of the values is simple. As the low doses can induce minimum radiolesions and one of these can affect the permeability of the cellular membranes and the mitochondria, it is possible for the enzyme to escape to the internal medium from the cellular medium. High doses can inactivate the synthesis of the enzyme. It is believed that the G.O.T. level may be a valuable index of radiation injury. (C.O.)

50355 EFFECTS OF PENETRATING RADIATION ON THE ULTRASTRUCTURE OF THE NUCLEAR MEMBRANE AND THE INTERRELATIONS BETWEEN THE NUCLEUS AND CYTOPLASM. Abramyan, K. S. Biol. Zh. Arm., 21: No. 11, 86-91(Nov. 1968). (In Russian).

The electron microscopic investigation of salivary gland cells of larval butterflies after irradiation at a dose of 20 KR with a dose rate of 700 R/min, was corrected. Preparations were made at 1.6 hr and 1 and 2 days, imagination of the layers of the nuclear membrane was seen and its structural components are described in detail. The migration of substances from the nucleus to the cytoplasm after irradiation was much greater than in the controls, and this was reflected in the intensified development of the apparatus in protein systhesis in the cytoplasm. (auth)

50356 RADIATSIONNAYA BIOFIZIKA I RADIOBIOLOGIYA RASTENII. (Radiative Biophysics and Plant Radiobiology). Rik, G. R. (ed.). Sbornik Trudov po Agronomicheskoi Fizike. Vypusk 17. Leningrad, Izdatel'stvo Kolos, 1969. 152p.

Twenty six articles are included on research in the field of radiobiology of plants, radiation biophysics and on the devices used in molecular, macromolecular, subcellular, cellular, and tissue studies. The first group of articles is devoted to the kinetics of formation and yield of free radicals in irradiated enzymes, grain seeds, plant pollens, and ethers of plant origin. Descriptions are given of isotopic gas analyzer used for determining the metabolism in plants and of the flow of rapidly changing gas. Intensimeters for quantitative measurements of volatile

materials and for determining the γ-ray effects on the volatility of some substances are also described. Several articles are concerned with the biological energy and effects of ionizing radiation on the cells, and with the electron microscopy of subcellular structures. The problems of γ-ray effects on growth and plant development and on radioresistance of grains and legumes are covered in the last articles. (R.V.J.)

50357 STEREOCHEMISTRY AND MECHANISM OF ENZYMATIC C-1,2 DEHYDROGENATION OF STEROIDS BY SEPTOMYXA AFFINIS. Abul-Hajj, Yusuf Jawdat. Madison, Wis., Univ. of Wisconsin, 1968. 103p.

Thesis.

The stereochemistry and mechanism of C-1,2 dehydrogenation of Δ^4-3-ketosteroids, 5α-3-ketosteroids, and 5β-3-ketosteroids were studied. Dehydrogenation of both Δ^4-3-ketosteroids and 5α-3-ketosteroids with respiring cells or cell-free extracts of Septomyxa affinis involves a stereospecific trans-diaxial removal of the 1α- and 2β-hydrogens. However, the introduction of the Δ^1-bond and 5β-pregnane-3,11,20-trione was found to occur with stereospecific removal of the 1β- and 2β-hydrogens. Kinetic isotope effects with both 1α-D and 2β-D of Δ^4-3-ketosteroids and 5α-3-ketosteroids suggest that the mechanism of dehydrogenation is consistent with a two-step process involving an enolization step followed by a hydride abstraction step. (Diss. Abstr.)

50358 EFFECT OF γ IRRADIATION ON COLLAGEN. 3. SOME PROPERTIES OF THE RECONSTITUTED FIBER FROM THE COLLAGEN SOLUTION IRRADIATED BY γ RAYS. Kubota, Minoru; Kimura, Shigeru (Tokyo Univ. of Fisheries). Hikaku Kagaku, 15: 8-13(Apr. 1969). (In Japanese).

At low irradiation dose, γ irradiated soluble collagen (γ-ISC) was partially precipitated as a fibrous substance when NaCl was added to make a final concentration of 5%. The higher the callagen concentration became, the larger was the critical dose for fiber formation. γ-ISC (0.095%) was fractionated into three fractions as follows: (I) dialysable peptides, (II) non-dialysable and non-fiber forming peptides, and (III) reconstituted fiber. Below the irradiation dose of 33.0×10^4R, the amount of Fraction I was so small that soluble collagen was assumed not to be cleaved into small peptides or amino acids. Fraction II increased slightly with the increase of dose and rapidly at above 22.5×10^4R. On the other hand, Fraction III decreased remarkably at above 22.5×10^4R, and the relative rations of II and III at that dose were about 60% and 40%, respectively. The tyrosine content of Fraction II was high (2.7%) at a low dose (2.7×10^4R) as compared with that of the native collagen (0.6%), although the hydroxyproline content was low (1.4%) as compared with that of native collagen (9.9%). These results suggested that the denaturation of the collagen molecule proceeded rapidly at above an irradiation dose of 22.5×10^4R and that the terminal region of the collagen molecule, rich in tyrosine but poor in hydroxyproline, was attacked by γ rays at an early stage of irradiation. The collagen fiber reconstituted from γ-ISC became less soluble in 0.1M acetic acid at 5°C, and above the dose of 22.5×10^4R the fiber was not dissolved at all. The thermal stability of the reconstituted fiber increased linearly with the increase of dose, and at the dose of 33.0×10^4 R the fiber was not gelatinized so easily in hot water (60°C). The optical rotation and denaturation temperature of acid soluble collagen of the reconstituted fiber from γ-ISC increased remarkably with the increase of dose, but the intrinsic viscosity increased slightly at the dose of 6.9×10^4 R and 12.3×10^4 R as compared with that of native collagen. From these results, it was assumed that the acid soluble collagen molecule was partially cross-linked at the early stage of γ irradiation, and that by giving more doses (above 22.5×10^4 R) the collagen fiber reconstituted from γ-ISC was converted into a cross-linked substance having a high thermal stability and not soluble in acid medium. (NSA of Japan)

50359 POSTRADIATION CHANGES IN DNA CATABOLISM IN RATS AND THE MECHANISMS OF THYMIDINURIA. Tereshchenko, O. Ya. (Inst. of Biophysics, Moscow). Biochemistry (USSR) (Engl. Transl.), 33: 787-91(Sept.-Oct. 1968).

Translated from Biokhimiya, 33: 969-75(Sept.-Oct. 1968).

The total catabolism of DNA in normal and irradiated rats was estimated at 1.5 mg and 9.8 mg DNA per day, respectively. The contribution of radiation destruction of cells to the destruction of radiosensitive tissues during the first 24 hr after irradiation is an order of magnitude higher than the contribution of radiation suppression of cell reproduction to this effect. The injurious action of radiation on cell populations of the intact organism is characterized by selectivity. (auth)

50360 LIPEMIA IN THE BLOOD OF URANIUM MINES EMPLOYEES INVESTIGATED BY LABORATORY SCREENINGS. Nosek, J. Cas. Lek. Cesk., 108: 275-6(Feb. 28, 1969).

A laboratory screening method was used to investigate blood samples of 1,659 miners and 1,969 controls. The miners were classified into three categories according to the length of their employment in the mines. The control group results were similar to those obtained in the group employed at the mines for 10 to 14 years; there were important differences between the control group and the miners employed for less than 10 years in the mines. All the values found were within the limits of the normal values, that is 400 to 800 mg%. (JPRS)

50361 URINE OUTPUT, SALINE INTAKE, AND ADRENAL FACTORS AFTER LETHAL WHOLE-BODY OR INTESTINAL IRRADIATION. Eddy, Hubert A.; Casarett, George W. (Univ. of Rochester, N. Y.). Radiat. Res., 37: 287-98(Feb. 1969).

Daily urine output and saline intake were measured up to 5 days after whole-body or intestinal x-irradiation (1460 R) of intact or adrenalectomized rats treated or not with adrenal cortical extract. Saline drinking caused polydipsia, polyuria, and increased urinary chloride concentration in nonirradiated rats. Irradiation abolished saline-induced polydipsia, caused hypodipsia, and caused water diuresis with normal or subnormal urinary chloride concentration on the first day, especially after whole-body irradiation, then progressive oliguria. Adrenalectomy delayed the full development of saline-induced polyuria and polydipsia in nonirradiated rats, enhanced the hypodipsic effect of irradiation on the first day, and reduced the diuretic effect of irradiation on the first day. Treatment with adrenocortical extract partly counteracted the early depressing and later enhancing effects of adrenalectomy on the saline-induced polyuria and polydipsia in nonirradiated rats and had little or no consistent effects on intact nonirradiated rats, on the fluid intake of irradiated rats, or on the urine output after intestinal irradiation, but depressed the diuresis observed in adrenalectomized rats on the first day after whole-body irradiation. (auth)

50362 HISTOCHEMICAL AND ULTRASTRUCTURAL LESIONS OF GUINEA PIG BRAIN AFTER 17-MeV BETA IRRADIATION. Pruszkowski, V.; Lierse, W.; Franke, H. (Univ., Hamburg). Acta Neuropathol., 11: 338-46(Nov. 1, 1968). (In German).

The heads of 17 guinea pigs of both sexes were irradiated homogenously by 17 MeV β irradiation. The dose of the single irradiation was 500 to 5000 R at a dose rate of 100 R/min. All the animals were killed 24 hr after the irradiation. By means of PAS and Astralblue reactions, globules containing mucoproteins and acid mucopolysaccharides could be detected mainly in the white matter. Their regional pattern depended on the dose. Beginning with 2000 R, shrunken and necrotic nerve cells were seen in the deep layers of cerebral cortex and medulla oblongata. Similar lesions were seen in the Purkinje cells. These lesions were confirmed by ultrastructural findings. Edema was found in astrocytes, but the extracellular spaces of the cortical gray matter were not enlarged. (BBB)

50363 CONTRIBUTION TO THE PROBLEM OF THE EFFECT OF RADIOIODINE ON THE THYROID FUNCTION IN GOATS. Ayoub, Laila Abdel Latif Lotfi (Tieraerztliche Hochschule, Hanover). Deut. Tieraerztl. Wochenschr., 75: 341-4(July 15, 1968). (In German).

Radioactive iodine was administered orally to two castrated male goats in doses of 50 μCi ^{125}I and 1000 μCi ^{131}I, respectively. Storage of iodine in the thyroid and the elimination of iodine into the blood plasma was measured on the basis of radioactivity of the protein-bound iodine fraction in the plasma (PBI). The thyroid was examined histologically at the end of the experiment. It was shown, that the uptake of radioactive iodine by the thyroid four and 24 hr after the injection of 50 μCi ^{125}I as well as 1000 μCi ^{131}I was not influenced. After the second day, however, there were signs of thyroid damage after a single dose of 1000 μCi ^{131}I. Uptake of radioactive iodine by the thyroid and elimination of labeled thyroid hormone into the blood markedly decreased. Damage of the thyroid by the dosage of 1000 μCi ^{131}I was proven histologically. (auth)

50364 ON THE CONTENTS OF RADIUM C AND RADON IN RADIOACTIVE MINERAL SPRING WATERS IN JAPAN. Sugihara, Takeshi (Yamanashi Univ., Kofu, Japan). Yamanashi Daigaku Gakugeigakubu Kenkyu Hokoku, No. 19, 272-9(1968).

The content of radium C (^{214}Bi) and radon was measured in hot and mineral spring waters in eight prefectures in Japan. There was a positive correlation between radium C and radon contents. There were negative correlations between radon and pH, between radium C and pH, and between radon and the rate of flow. The highest content of radon was 3260×10^{-10} curie/l in the Dairokuten mineral water of Masutomi, Yamanashi Prefecture. The highest content of radium C was 3280×10^{-10} curie/l in the Dairokuten mineral water. (NSA of Japan)

50365 MODIFICATION OF RADIATION RESPONSE IN SYNCHRONIZED HeLa CELLS BY METABOLIC INHIBITORS:

EFFECTS OF INHIBITORS OF DNA AND PROTEIN SYNTHESIS. Djordjevic, B.; Kim, J. H. (Sloan Kettering Inst. for Cancer Research, New York). Contract AT(30-1)-910. Radiat. Res., 37: 435-50(Mar. 1969).

Synchronized cultures of HeLa cells x-irradiated at different stages of the division cycle were incubated with inhibitors of DNA and protein synthesis. Thymidine at concentrations that inhibit DNA synthesis increases survival of cells irradiated in the G_1–S transition or S phase when present in the medium during a 3.5-hour postirradiation period. There was no such effect of thymidine on cells irradiated in the early G_1 phase. Inhibitors of DNA synthesis such as hydroxyurea, which at high concentrations are toxic even to unirradiated cells, at nontoxic concentrations will enhance survival of cells irradiated in the S phase, but will decrease survival of cells irradiated in the G_1 phase. At slightly toxic concentrations, hydroxyurea enhances the effect of irradiation even in cells irradiated in the S phase. Acetoxycycloheximide, an inhibitor of both DNA and protein synthesis, increases survival in irradiated cells in a manner similar to that of thymidine, while puromycin, an inhibitor of protein synthesis decreases survival of cells irradiated in the S phase. It was concluded that inhibition of DNA synthesis, but not inhibition of protein synthesis, has a beneficial effect on survival of x-irradiated cells. (auth)

50366 EFFECT OF PROPYLTHIOURACIL ON GROWTH AND MORPHOLOGICAL CHANGES OF THYROID INTRAOCULAR GRAFTS X IRRADIATED IN VITRO BEFORE TRANSPLANTATION. Pavlovic-Hournac, Miroslava; Radivojevic, Dusanka; Pantic, V. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). Iugoslav. Physiol. Pharmacol. Acta, 2: 39-46(1966).

The regenerative ability of rat thyroid grafts irradiated in vitro with 200 to 1800 R was studied in hosts with thyrotropin (TSH) secretion stimulated by continual treatment with propylthiouracil (PTU). Weights of nonirradiated grafts and of those irradiated with 200 R were appreciably increased after continual treatment of hosts with PTU. The difference of weights of nontreated and PTU-treated nonirradiated grafts was significant; however, the difference for grafts exposed to 200 R was much smaller. The growth of grafts irradiated with 400 to 1800 R could not be stimulated with PTU. Histological study showed that 25 days after treatment with PTU, hypertrophy and hyperplasia of glandular cells, desquamation of epithelium, and a strong lymphocyte infiltration occurred in nonirradiated grafts, also in grafts irradiated with 200 R. Grafts irradiated with 400 and 600 R had a microfollicular structure. Their nuclei contained a small amount of chromatin and were occasionally hypertrophied. Desquamation of epithelium often occurred. Lymphocyte infiltration was much stronger than in control glands so that follicles were completely separated one from another. The destruction of follicles was pronounced in grafts irradiated with 1200 and 1800 R. There were, however, some grafts with microfollicular structure and with a very dense population of cells in the follicular wall. (BBB)

50367 EFFECTS OF RADIOTOXINS ON THE SYNTHESIS OF RAPIDLY LABELED NUCLEAR RNA AND PROTEIN IN HeLa CELLS. Kalendo, G. S.; Merkulov, A. S.; Kuzin, A. M. (Inst. of Biophysics, Pushchino-on-Oka, USSR). Radiobiologiya, 9: 483-7(July-Aug. 1969). (In Russian).

The influence of various concentrations of radiotoxins on the metabolism of nuclear RNA and protein in cultured HeLa cells was investigated using radioautography. It was shown that low concentrations of radiotoxins stimulate the synthesis and transport of short-lived nuclear fractions of RNA and the synthesis of nuclear and cytoplasmic protein. Large concentrations of radiotoxins inhibit the protein and nucleic acid metabolism. In this case the synthesis of the short-lived fractions of RNA is suppressed to a greater degree. Possible mechanisms of the action of radiotoxins are discussed. (tr-auth)

50368 POSSIBLE ROLES OF KNOWN ENZYMES IN THE BREAKDOWN OF RNA IN X-IRRADIATED ESCHERICHIA COLI. Pecevsky, I.; Kucan, Z. (Ruder Boskovic Inst., Zagreb). Croat. Chem. Acta, 40: 171-9(1968).

Breakdown of adenine-^{14}C-labeled RNA of x-irradiated E. coli proceeds at the same rate in the presence and in the absence of chloramphenicol, indicating thus that pre-existing enzymes are responsible for the process. Although considerable amounts of RNA are broken down upon incubation of bacteria in some salt solutions, the breakdown is enhanced by irradiation only when the incubation medium contains both K^+ and phosphate. Among the breakdown products of adenine-^{14}C- and uracil-^{14}C-labeled RNA were found nucleoside diphosphates together with larger amounts of nucleoside monophosphates and some triphosphates. The irradiation-induced breakdown of RNA in a strain lacking ribonuclease I proceeds at the same rate as in E. coli B. It is proposed that ribonuclease I does not take part in degradation, while both ribonuclease II and polynucleotide phosphorylase are responsible for the process. (auth)

Immunology

Refer also to abstracts 50245, 50613, 50623, 50813, 50825, 50954, and 50957.

50369 (ORO–3120-8) ANAPLASMOSIS OF CATTLE. Progress and Final Report. Edds, G. T.; Neal, F. C.; White, F. H. (Florida Univ., Gainesville). Mar. 1969. Contract AT(40-1)-3120. 15p. Dep. CFSTI.

Blood infected with Anaplasma marginale was x-irradiated with doses of more than 50 kilorads and inoculated into splenectomized calves. There was a delay in the onset of parasitemia and a decrease in the severity of clinical symptoms. Tests were conducted on the safety and antigenic activity of the anaplasmosis vaccine. The percent of infected cells, the platelet count, and initial and recurrent cycles were determined in vaccinated animals following inoculation of the parasitized blood. Vaccinated animals were also inoculated with Babesia bigemina. Results are shown by means of graphs. (H.L.W.)

50370 (SAN–410-88) BASIC STUDIES OF THE IMMUNE RESPONSE AND THE EFFECT OF RADIATION ON THE RESPONSE. Progress Report, June 1, 1968–May 31, 1969. Dixon, Frank J. (Scripps Clinic and Research Foundation, La Jolla, Calif. Dept. of Experimental Pathology). Contract AT(04-3)-410. 10p. Dep. CFSTI.

The following projects were included in the principal investigator's research during the past 12 months. The nature, source, and metabolism of basement membrane antigens in the urine and serum of humans and the effects of glomerulonephritis on these acidic glycoproteins were investigated. The incidence and nature of recurrent nephritis in 100 renal homotransplants were studied and it was determined that where the type of nephritis was known, that the same process occurred in the transplant. Determination of the amounts of antigen of chronic serum sickness nephritis deposited in the kidneys of nephritic rabbits, and the turnover rate of these complexes was made. The pathogenic mechanisms of LCM infection in mice were found to be; formation of circulating viral-antibody complexes, and injury of virus-containing host cells by anti-viral antibodies and sensitized lymphoid cells. The effects of incidental viral infections (Polyoma) in LCM-infected mice were found to be a hastening of the autoimmune responses to either infection. Continued study of the suppressive effect of antibody on antibody formation indicated the extreme specificity of such suppression at the level of individual antigenic determinants. Investigations in autoimmune thyroiditis continued with studies of cellular kinetics during both the immune response and the induction of immunologic unresponsiveness and the termination of the unresponsive state once it is induced. (E.R.B.)

50371 IMMUNOSUPPRESSIVE EFFECTS OF ACTINOMYCIN D AND RADIATION. Jennings, B. R. (Univ. of Tennessee, Memphis). Contract AT(40-1)-3489. RES. J. Reticuloendothel. Soc., 6: 50-8(Feb. 1969). (ORO–3489-4).

Since the characteristics of radiation and actinomycin D immunosuppression are different, the possibility that administration of the two agents in combination might result in a potentiated effect was tested. In mice previously immunized with tetanus toxoid, administration of doses of actinomycin D (4 μg) and x irradiation (100 R) well below those generally used for immunosuppression produced a decrease in antitoxin formation which was greater than that noted following individual administration of these agents. Suppression is more pronounced when the agents are given 1 or 2 days before the secondary antigenic stimulus. The degree of suppression was noted to be dose dependent. When animals were exposed to both agents at 2 days before antigen injection, there was a 60.0% repression, compared to 39.1 and 15.6% respectively for radiation and actinomycin D each administered alone. Similarly, both agents given at 1 day before antigen resulted in 60.0% repression, compared to 36.5 and 14.7% for radiation and actinomycin D, respectively. The two agents in combination given within 1 hr after the second antigenic stimulus produced a 17.3% suppression. A potentiation of suppression was not evident when either agent was given before the secondary antigenic stimulus followed by administration of the other agent. Actinomycin D given 1 or 2 days after the antigenic stimulus amplified the effects of 650 R given 4 days postantigenic stimulation. (BBB)

50372 STUDIES ON THE IMMUNE RECONSTITUTION OF SUBLETHALLY IRRADIATED MICE BY PERITONEAL MAC-

ROPHAGES. Gershon, Harriet; Feldman, Michael (Weizmann Inst. of Science, Rehovoth, Israel). Immunology, 15: 827-35(Dec. 1968).

Experiments were designed to determine whether peritoneal macrophages from normal mice, preincubated with sheep red blood cells (SRBC), can restore the immune response of sublethally irradiated mice to this antigen. Recipient mice were x-irradiated with a dose of 550 R, and 48 hr later macrophages from normal donor mice were incubated in vitro with whole SRBC. The washed macrophages were then injected into irradiated recipients. In this experiment no irradiated mice, experimental or control, evinced a detectable anti-SRBC response. Since the irradiation dose of 550 R was an arbitrary one based on previous studies with Shigella in C57BL mice, the threshold dose of irradiation above which CD_2 mice were unable to produce a detectable response to SRBC and for Shigella paradysenteriae antigen was determined. The minimum dose of irradiation which eradicated all but the slightest suggestion of a response to SRBC fell between 400 and 450 R, whereas to obliterate the anti-Shigella response, x-ray doses of 550 R or more had to be used. Thus the response to Shigella was less radiosensitive than the anti-SRBC response. Sublethally irradiated mice (550 R) injected with peritoneal macrophages from normal donors preincubated with Shigella antigen or injected simultaneously with macrophages and Shigella evinced a strong anti-Shigella response. No such reconstitution of the immune response against SRBC was observed, even when lower irradiation doses and phagocytosis-enhancing incubation media were used. Possible reasons for the different response to Shigella and SRBC are discussed. (BBB)

50373 EFFECT OF THE NUMBER OF PRIMED CELLS ON THE PRODUCTION OF IgM AND IgG ANTIBODIES IN AN ADOPTIVE SECONDARY RESPONSE. Kontiainen, Sirkka; Maekelae, O. (Univ. of Helsinki). Int. Arch. Allergy Appl. Immunol., 34: 417-27(1968).

Irradiated syngeneic hosts were used to study IgM and IgG antibody response in transferred primed cells. The hapten used was 4-hydroxy-3-iodo-5-nitrophenylacetic acid (NIP). For immunization it was coupled to chicken globulin (NIP-CG). Donors of primed spleen cells were immunized at the age of 5 months with 0.5 mg of alum-precipitated NIP-CG. The recipient rats were given 760 rad of ^{60}Co γ radiation, followed by a spleen cell suspension from the immunized donor rats. Immune inactivation of hapten-coupled bacteriophage was used to assay antibody. IgM and IgG antibodies were determined by the combined reduction-hapten-inhibition method. Excellent memory was found in the production of IgM antibodies by primed cells. Proportionally more IgM anti-hapten was produced when the density of primed cells was low than when the density was high. (BBB)

50374 IMMUNOSUPPRESSION AND ITS COMPLICATIONS. Woodruff, Michael (Univ. of Edinburgh). Proc. Roy. Soc. Med., 62: 411-16(Apr. 1969).

Experimental and clinical use of ionizing radiations, among several other agents, to induce immunosuppression is reviewed, particularly in relation to tissue transplantation. The survival of skin homografts is increased by irradiation of the prospective recipient prior to grafting. Whole-body, extracorporeal-shunt, and local-graft irradiation was studied. Some of the possible mechanisms by which radiation and other agents may cause immunosuppression are listed. It was suggested that neither irradiation nor the cytotoxic and antiproliferative drugs affect any cellular activity peculiar to or distinctive of the immunological process as such. These agents may cause immunosuppression simply by preventing the multiplicative expansion of a small reactive lymphocyte population into the relatively large population of reactive cells characteristic of the sensitized state. However, this interpretation may be an oversimplification and may not hold good for immunological reactions mediated through humoral antibodies. It has been shown that x irradiation in appropriate doses may interfere with the capacity of macrophages to process antigen to an immunogenic state. Immunosuppression in clinical practice is also discussed. Treatment with radiation and other immunosuppressive agents entails the risk of complications, some of which may be extremely serious or even fatal. These complications include infection, wasting, hemorrhage associated with thrombocytopenia, and neoplastic disease. (BBB)

50375 THE EFFECT OF ANTIGEN DOSE ON THE ADOPTIVE IMMUNE RESPONSE: VARIATIONS IN THE IgM/IgG RATIO. Kontiainen, Sirkka (Univ. of Helsinki). Ann. Med. Exp. Biol. Fenn. (Helsinki), 46: 273-8(1968).

Rats irradiated with 800 R were used as recipients of spleen cells from donor rats immunized with a hapten-protein conjugate. The pooled and transferred cells given the irradiated, syngeneic recipients were followed by an antigen injection (secondary stimulation). Antibody was assayed by immune inactivation of hapten-coupled bacteriophage. The combined reduction-hapten-inhibition method was used to determine the contributions of IgC and IgM to the titer. When 5000 to 0.5 μg of antigen was used for secondary stimulation, there was an excellent antibody response. The highest antibody titers were found in groups stimulated with 500 to 15 (Experiment I) or 500 to 50 (Experiment II) μg of antigen. A high antigen dose (5000 μg) reduced the response and the IgG titer diminished more than the IgM. With low antigen doses (5 or 0.5 μg) the total response was again reduced, but the IgM titer diminished more than the IgG. Detectable IgG appeared earlier after low than after high antigen doses. (BBB)

50376 DIFFERENCES IN ANTIBODY PRODUCTION AFTER ADOPTIVE TRANSFERS OF SYNGENEIC AND ALLOGENEIC SPLEEN CELLS TO IRRADIATED MICE. Dvorak, R. (Inst. of Microbiology, Prague). Folia Microbiol. (Prague), 13: 459-67 (1968).

Immunologically competent spleen cells from syngeneic or allogeneic donors were transferred to supralethally irradiated mice (1100 R, ^{60}Co). At the same time, or 72 hr after transfer, sheep red cells were administered intraperitoneally to the mice. Five days after administration of the sheep red cells, antibody production was determined in host spleen fragments by the method of hemolysis in agarose. It was found that an incompatible allogeneic environment markedly stimulated proliferation of the donor cells and that proliferation of clones of cells reacting specifically to sheep red cells by antibody production was also stimulated. Examination of the spleens of irradiated hosts that received syngeneic spleen cells showed small whitish and pinkish foci on the surface of the spleen 5 days after transfer of the cells; by 8 days these foci had increased in size and in some places merged. Histological and cytological techniques verified that the basis of these nodules in the spleens were foci of actively regenerating hemopoiesis, with large numbers of dividing erythroblasts and myelocytes. In the same animals, on the fifth day after transfer the white spleen pulp was greatly reduced and contained a few reticular cells and small lymphocytes, without signs of cell division. Slight proliferation of the white pulp cells was histologically discernible on the eighth day after the transfer of syngeneic spleen cells. On the fifth day after the transfer of allogeneic spleen cells to irradiated hosts, white spleen pulp of the hosts showed pronounced proliferation of the lymphoid cells. (BBB)

50377 SOME EFFECTS OF GAMMA RADIATION ON TRYPANOSOMA CRUZI, CULTURE, AND BLOOD FORMS. Chiari, E.; Neto, E. Mansur; Brener, Z. (Instituto Nacional de Endemias Rurais, Belo Horizonte, Brazil). Rev. Inst. Med. Trop. Sao Paulo, 10: 131-7(May-June 1968).

In irradiated cultures and blood forms of T. cruzi, determinations were made of lethal doses, loss of infectivity, morphological changes effects of the radiation on growth curves of culture-forms, and immunization achieved with irradiated cultures. This flagellate was irradiated with ^{60}Co at various doses. The MR strain culture forms in Yaeger's LIT liquid medium were submitted to γ rays and then inoculated into mice. All animals inoculated with alagellates submitted to 15 and 30 Krad became infected. With doses of 60 and 90 Krad, infection was found in 60% and 10% of the animals, respectively. The animals were not infected when inoculated with culture forms irradiated with 120 Krad. Study of the growth curve of cultures after various doses or irradiation showed that the number of flagellates surviving is closely correlated with the increase of dose. Attempts at immunization were made by injecting mice with culture forms irradiated with 120 Krad; however, the presence of protective antibodies was not observed. Blood forms displayed greater susceptibility to irradiation than culture forms, and 30 Krad was enough to hinder their infectivity in mice. These forms, however, did not afford any immunity against reinoculation with the parasites. No morphologic changes nor any interference in the in vitro reproduction of T. cruzi were observed after the irradiation of blood forms with 30 Krad. A 60-Krad dose hindered the growth of blood forms in LIT liquid medium. No radiolysis was observed at the doses used, but motility of the flagellates was rapidly affected by 466 Krad after doses of 350, 245, and 155 Krad, motility could be observed up to 72 hrs postirradiation, after whch it gradually decreased. Doses over 155 Krad had a lethal effect on the culture forms. (BBB)

50378 THE EFFECT OF ANTILYMPHOCYTIC IgG ON UNSENSITIZED AND SENSITIZED SPLEEN CELLS IN VIVO AND IN VITRO. James, K.; James, Valerie S.; Pullar, Diane M. (Medical School, Edinburgh). Clin. Exp. Immunol., 4: 93-100(Jan. 1969).

The effect of antilymphocytic antibody treatment on the humoral

antibody-producing potential of transferred nonsensitized spleen cells was studied in irradiated recipients. The recipients of the various suspensions of spleen cells were 3- to 6-month-old male rats receiving 500 rad of whole-body x irradiation. Rat spleen cells sensitized to bovine serum albumin and treated in vitro with anti-lymphocytic IgG were unable to transfer secondary immunological (humoral) responsiveness to the x-irradiated isogeneic rats. Similar in vitro treatment of unsensitized spleen cells has a significant, though less marked, effect upon their ability to confer primary humoral responsiveness to irradiated recipients. (BBB)

50379 EFFECT OF PRELIMINARY IRRADIATION OF MICE ON RADIORESISTANCE OF IMMUNOLOGICALLY COMPETENT SPLEEN CELLS. Petrov, R. V.; Cheredeev, A. N. (Inst. of Biophysics, Moscow). Nature (London), 220: 1349-50(Dec. 28, 1968).

The aim of the studies described was to compare the radioresistance of immunologically competent cells from intact and previously irradiated animals. Cells were counted using the plaque technique. The injection of spleen cells stimulated by antigen from normal mice into lethally irradiated recipients resulted in the accumulation of $\sim 2{,}500 \times 10^{-8}$ antibody-forming cells in their spleens, whereas use of the same quantity of transplanted cells from previously irradiated donors (500 R) resulted in a significantly smaller accumulation of cells producing antibody. Cell suspensions from intact and previously irradiated donors were also irradiated in vitro, and dose response curves for three groups of the cell populations are shown. The greatest difference in accumulation of antibody-forming cells, in comparison with the normal cell suspension, occurred when the spleen cells were isolated from the donors 21 days after the preliminary irradiation. The results indicate that the population of immunocompetent spleen cells in the body of previously irradiated mice is significantly more radioresistant than that in intact animals. Possible explanations are advanced. (UK)

50380 IMMUNOLOGICAL RESTORATION OF THE LOCALLY IRRADIATED SPLEEN WITH CIRCULATING LYMPHOCYTES. Simic, M. M. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). Nature (London), 220: 1354-5(Dec. 28, 1968).

It was found that although the production of haemolysins by normal rats after intravenous injection of sheep red blood cells (SRBC) occurs almost entirely in the spleen, heavy local irradiation of this organ reduces the capacity of the animal to form haemolysin only if combined with sublethal total body irradiation. Irradiation of the spleen alone, when performed shortly after administration of SRBC, results in an apparently normal haemolysin response, deriving almost completely from the irradiated organ. There is little doubt that the radiation doses used (~10,000R) killed all lymphoid cells in the spleen at the time of irradiation, so that restoration of the response to an antigenic stimulus must have derived from a circulating cell population. In the studies described two approaches were made in an investigation of this cell population: first, by limiting the time available for the appropriate cells to migrate into the spleen; second, by supplementing the radiation depleted circulating pool with suitable cells. The studies demonstrated the usefulness of local irradiation of the spleen to determine the nature of circulating cells which can effect an immune response, and their site of action. (UK)

50381 STUDIES ON IMMUNOLOGICAL PARALYSIS. I. A CONSIDERATION OF MACROPHAGE INVOLVEMENT IN THE INDUCTION OF PARALYSIS AND IMMUNITY BY TYPE II PNEUMOCOCCAL POLYSACCHARIDE. Howard, J. G. (Univ. of Edinburgh); Siskind, G. W. Clin. Exp. Immunol., 4: 29-39(Jan. 1969).

The effect of whole-body x irradiation on induction of paralysis with type II pneumococcal polysaccharide (SII) was studied in mice. Induction of paralysis with SII in nonirradiated mice was slightly facilitated by administration in 10 injections during 5 weeks as compared with the equivalent total dose in a single injection. No improvement in degree of immunization was afforded by repeated injection. To determine whether mice could be paralyzed with lower than normally paralytic doses of SII if their immune responsiveness was suppressed by prior irradiation, they were exposed to 500 rad whole-body x irradiation 24 hr before the injection of varying doses of SII. After an interval of 49 days they received an optimal immunizing dose of 0.5 μg SII and were challenged with viable pneumococci 10 days later. The long interval between the initial dose of SII and the second immunizing dose was to allow time for recovery from nonspecific effects of irradiation. Although mice were paralyzed by the usual high doses (100 to 200 μg SII), immunization occurred normally with lower doses. Thus, upon recovery from the effects of x irradiation, the animals developed a normal immune response despite the fact that antigen had been present during the recovery period. Evidently tolerance cannot be produced with normally immunizing doses of polysaccharide if the immunizing effect is suppressed by irradiation. (BBB)

50382 USE OF IRRADIATED THIRD-STAGE LARVAE ON ANGIOSTRONGYLUS CANTONENSIS AS ANTIGEN TO IMMUNIZE ALBINO RATS AGAINST HOMOLOGOUS INFECTION. Lee, Sheridan H. (Univ. of Hawaii, Honolulu). Proc. Helminthol. Soc. Wash., D. C., 36: 95-7(Jan. 1969).

The ability of larvae irradiated with 20 or 40 kR of ^{60}Co γ rays to immunize rats was determined. The radiation dose of 40 kR prevented further development of the third-stage larvae of Angiostrongylus cantonensis, yet the antigenicity of their larvae was not lost, as indicated by the reduced worm burden of the immunized rats when challenged. Immunity acquired by the rats did not depend on the existence of live worms within the rats. The complete absence of worms in two of six rats and the relative low number of worms in other rats of this group suggested that two feedings of 200, 40-kR treated larvae offer the best immunizing procedure. Sterile worms were recovered from the experimental rats given 20-kR treated larvae. The protracted stay of young adults in the subarachnoid space should have caused the rats to have a stronger immune response, but the quality of immunity measured in terms of worm burden after reinfection did not confirm this. The dose of 40 kR made the third-stage larvae of A. cantonensis serve as a better antigen as compared with 20 kR against homologous infection. (BBB)

50383 KINETICS OF RELEASE OF ^{86}Rb AND HEMOGLOBIN FROM ERYTHROCYTES DAMAGED BY ANTIBODY AND COMPLEMENT. Hingson, Dickson J. (Harvard Medical School, Boston); Massengill, R. Kemp; Mayer, Manfred M. Immunochemistry, 6: 295-307(Mar. 1969).

Sheep erythrocytes carrying 100 to 200 SAC'1a,4 (rabbit antibody and guinea pig complement) were treated with ^{86}Rb and then with varying dilutions of guinea pig C'2 at 30°C. At the peak of SAC'1a,4,2a generation, C'-EDTA (ethylenediaminetetraacetic acid) was added and kinetic sampling was begun by means of a simple filtration technique for rapid separation of cells from medium. Release of $^{86}Rb^+$ started after a lag phase of about 0.5 to 1.0 min, and followed first-order kinetics during a prolytic phase lasting one to 15 min, depending on C'2 multiplicity. Cell lysis then ensued, with first-order release of hemoglobin (Hb). The kinetics of $^{86}Rb^+$ and Hb release from the control populations required for hemolytic experiments are compared with data from the experimental populations. A physiological interpretation of the controls is suggested. (auth)

50384 IMMUNOLOGIC STUDIES OF INBRED RATS AFTER EXPOSURE OF NORMAL AND NEOPLASTIC TISSUES TO LASER ENERGY OR THE ELECTROCAUTERY. Bard, David S.; Minton, John Peter; Ketcham, Alfred S. (National Cancer Inst., Bethesda, Md.). Amer. J. Surg., 116: 807-12(Dec. 1968).

The possible immunizing effect of neodymium laser irradiation was studied in rats bearing methylcholanthrene-induced tumors and compared with that of electrocautery tissue destruction. Normal muscle or neoplastic tissue was subjected to partial ablation, and the specific immunologic effects were investigated by measuring each host's circulating antibody response to his own treated and untreated tissues and by comparing the antigenic composition of each host's treated and untreated tissues in gel diffusion. Three consecutive 450-J pulses of laser energy were delivered to each tumor. It was thought that new and foreign molecules might be produced in the injured tissue, some of which might be antigenic in their hosts. Low titers of serum hemagglutinating (HA) antibodies to damaged muscle tissue were found in one of three animals with extensively lasered muscle, and in one of four animals with cauterized muscle. Only one animal displayed both a positive antibody titer and evidence by gel diffusion of molecular alteration in its damaged muscle. Low titer HA antibodies to tumor tissue were found in one of three hosts with extensive but partially lasered tumor and the one host with partial electrocauterization of its tumor. Prior absorption, however, with untreated tumor extract inhibited the HA reaction in both cases. This suggests that the antibodies were directed primarily at the untreated tumor rather than to altered molecules in the damaged tumor. (BBB)

50385 THE PREVENTION OF EARLY VACCINIA-VIRUS-INDUCED CYTOPATHIC EFFECTS BY INHIBITION OF PROTEIN SYNTHESIS. Bablanian, R. (State Univ. of New York, Brooklyn). J. Gen. Virol., 3: 51-61(July 1968).

Infection of LLC-MK-2 cells with the International Health Division strain of vaccinia virus caused rounding of all cells within two to three hr after infection. Puromycin, at a concentration of

330 μg/ml., completely prevented the early virus-induced cytopathological changes as well as virus multiplication; however, at 33 μg/ml the compound did not prevent the cytopathic effects of vaccinia virus, in spite of the fact that virus multiplication was largely inhibited. Treatment of cells for four hr with puromycin at 330 μg/ml did not alter the rate of cell division when the compound was removed. When the antibiotic (330 μg/ml) was removed from infected cultures after a treatment period of 4 hr, virus-induced cell damage began almost immediately after removal and by 1 hr all cells were rounded. Actinomycin D, 5 μg/ml, also protected the cells from the early vaccinia-virus-induced cytopathic effects. At 0.5 μg/ml, although growth of virus was inhibited, no protection against viral cytopathic effects was observed. In LLC-MK-2 cells virus-induced morphological damage was not prevented by p-fluorophenylalanine, 5-fluoro-2′-deoxyuridine, and isatin-β-thiosemicarbazone, compounds known to inhibit the reproduction of vaccinia virus. Ultraviolet-irradiated virus, that had lost its infectivity, was still capable of causing early cell damage. These findings suggest that the early virus-induced cytopathological effects, previously considered the toxic effects of the virus, are brought about by the synthesis of virus-induced protein(s). (auth)

50386 STUDY OF THE IMMUNOLOGICAL RESTORATION OF ALLOGENEIC HEMATOPOIETIC RADIOCHIMERAS. **Hrsak, I.; Nouza, K.; Kolar, V.; Mathe, G. (Hopital Paul-Brousse, Villejuif, France). Rev. Fr. Etud. Clin. Biol., 13: 887-93(Nov. 1968). (In French).**

The secondary syndrome in both animal and human radiation chimeras comprises two main components: the early, proliferative phase, which seems to be thymus independent and may be best controlled by immunosuppressive drugs or heterologous anti-lymphocyte serum, and the late phase, probably thymus dependent, characterized by profound aplasia of lymphoid tissues, which at present cannot be controlled. Allogeneic murine radiation chimeras were treated with additional i.v. transfusions of donor bone marrow cells or by the i.p. transplantation of multiple thymus grafts from donor or genetically unrelated (third party) mice. The survival at 60 days and immunological reactivity against sheep red cells (SRBC), allogeneic skin grafts, Mycobacterium tuberculin and Canadidin antigen (at the 35th and 60th day) were compared in non-treated and treated animals. Untreated chimeras reacted only feebly to SRBC and skin grafts, whereas the reactions against mycobacterial and fungal antigens were essentially the same as in normal non-irradiated mice. The second transfusion of donor bone marrow improved the 60 days survival, but had no effect on the immunological activity of chimeras. On the other hand, donor and third party thymus grafts improved at least temporarily, the immune responses of some grafted animals. Evidence is obtained that a temporary take of thymus grafts was necessary for the lympho-stimulating effect to be realized. A humoral factor seems to be involved more probably than the cellular migration of thymus cells to the lymphoid tissues. The implication of these results to the possible control of the aplastic aspect of the secondary syndrome in animal experiments and clinical practice is discussed. (auth)

50387 RESTORATION OF IMMUNE RESPONSES FOLLOWING THYMECTOMY AND IRRADIATION. **Rosenthal, Moshe (CIBA Aktiengesellschaft, Basel). Strahlentherapie, 137: 596-611(May 1969). (In German).**

The recovery of the immunologic competence after total body irradiation and bone marrow transplantation was followed in normal and in thymectomized mice. Thymectomized radiation-chimeras show a persistent lymphopenia in peripheral blood, a defective lymphatic repopulation of the paracortical region of the lymph nodes and of the periarterial zone of the spleen pulpa. A lasting and reduced response of the lymphatic tissue toward stimulation with sheep erythrocytes or phytohemagglutinin and a permanent reduced ability to produce antibodies toward sheep erythrocytes are also noted. With increased radiation dose, a more pronounced effect of the irradiation is observed after previous thymectomy. Transplantation of thymic tissue below the renal capsule or in an intraperitoneal diffusion chamber partially restitutes these capabilities. The loss of immunologic reaction in thymectomized radiation-chimeras is explained through a disturbance within a radiosensitive population of thymus-dependent antigen-reactive cells. (auth)

50388 STEM CELL RENEWAL IN FROZEN MARROW. **O'Grady, Lois F.; Lewis, Jerry P. (Univ. of California, Davis). Cryobiology, 5: 250-3(Jan.-Feb. 1969).**

Irradiated recipients were used to demonstrate the effectiveness of frozen bone marrow cells in renewing the hematopoietic stem cell population in CAF_1 mice. Use of a highly efficient cooling and thawing regimen confirmed that bone marrow stem cells survive the processes of freezing and thawing and retain their capacity to initiate stem cell renewal at a time and rate similar to that found with fresh marrow cells. The syngeneic recipients were x irradiated with 750 R, a dose that resulted in endogenous colony production of less than 0.2 colony per mouse. Within 4 hr of irradiation, the animals were injected intravenously with 45,000 fresh cells or 60,000 cells which had been frozen in either dimethyl sulfoxide or glycerol. The suspensions were cooled at 2°C/min to −100°C, rapidly thawed, and diluted with 35% glucose and 6% dextran. There was no difference among the 2 groups at the 7 days studied. During the first 4 days following marrow transplantation, there was no rise in the number of assayable stem cells; however, on day 5 and thereafter in both groups there was a rapid increase in hematopoietic stem cells in the splenic tissue of the irradiated animals. Thus stem cells, preserved in either glycerol or dimethyl sulfoxide and cooled to −100°C, replenished their own population at the same time and at the same rate as stem cells from fresh marrow. (BBB)

50389 EFFECTS OF SOME CELLULAR ANTIGENS ON LYMPHOCYTES AND THE NATURE OF THE MIXED LYMPHOCYTE REACTION. **Ryall, R. D. H. (Groote Schuur Hospital, Cape Town). Nature (London), 223: 196-7(July 12, 1969).**

Reference is made to the communication by Hardy and Ling in Nature 221: 545(1969) in which it is pointed out that irradiated lymphoma cells markedly activate human lymphocytes in a mixed cell reaction in vitro. Ryall states that this suggests to him, as a radiotherapist concerned with the care of lymphoma patients, a rational explanation of the frequent observation in this group of diseases that irradiation of a group of lymphomatous glands, with a single small dose, results in rapid clinical regression of other lymphomatous masses at distant sites in the body. Hardy and Ling also indicate that activation may require two populations of living cells, and are concerned about the differences between live and dead cells in this regard. Ryall suggests that a study of membrane potentials of cells may be of assistance in this connection. A reply by Hardy and Ling is appended. (UK)

50390 INFLUENCE OF NEONATAL THYMECTOMY ON CLONING CAPACITY OF BONE MARROW CELLS IN MICE. **Trainin, N. (Weizmann Inst. of Science, Rehovoth, Israel); Resnitzky, P. Nature (London), 221: 1154-5(Mar. 22, 1969).**

Reference is made to an observation by Till and McCulloch (Radiat. Res., 14: 213(1961)) that when syngeneic bone marrow cells were injected intravenously into sublethally irradiated mice, macroscopic nodules, apparently derived from single cells, appeared in the spleens of the recipients. This in vivo cloning of bone marrow cells was used to investigate changes in the bone marrow population in mice after neonatal thymectomy. The irradiation employed was a single dose of 800 to 900 R total body. Within 2 to 3 hr of irradiation the mice were injected intravenously with bone marrow suspension. The spleens were examined 9 days later and the macroscopic noduli were counted, and the clones classified. The total number of colonies counted in the spleens of animals that received bone marrow cell suspensions from thymectomized donors was much lower than in recipients of cells from intact donors. The most prominent change observed in the cellular distribution of the bone marrow of thymectomized mice was a significant increase in the number of blasts (from 2.7 in normal to 7.1 in thymectomized animals). Most of the other cell types were within the normal range. The number of mitotic cells was smaller than in normal mice, indicating that the bone marrow of thymectomized animals was less active than in normal animals. The experiments demonstrated that the cloning capacity of bone marrow cells of thymectomized mice was impaired in relation to that of intact controls, and because each spleen colony appeared to be derived from a single multipotent bone marrow stem cell, the results suggested the existence of a regulatory function exerted by the thymus on the stem cell population of the bone marrow. It is concluded that absence of the thymus leads to maturation arrest of bone marrow tissue, the exact mechanism of which is not yet known. (UK)

50391 IMMUNIZATION OF RHESUS MONKEYS AGAINST SCHISTOSOME INFECTION BY CERCARIAE EXPOSED TO HIGH DOSES OF X-RADIATION. **Li Hsue, S. Y.; Hsue, H. F.; Osborne, J. W. (Univ. of Iowa, Iowa City). Proc. Soc. Exp. Biol. Med., 131: 1146-9(Sept. 1969).**

Strong acquired resistance against schistosome infection in rhesus monkeys can be induced by previous immunizations with cercariae exposed to large amounts of x radiation; i.e., 24,000 or 48,000 R. This indicates that acquired resistance against schistosome infection can be induced exclusively from functional antigen produced after contact or deterioration of the schistosomular stage in the dermal tissues. (auth)

50392 SECONDARY DISEASE IN RADIATION CHIMERAS. Congdon, C. C. (Oak Ridge National Lab., Tenn.). pp 21-7 of Bone-Marrow Conservation, Culture, and Transplantation. Vienna, International Atomic Energy Agency, 1969.

From Conference of Panel on Bone-Marrow Conservation, Culture, and Transplantation, Moscow. See STI/PUB-219; CONF-680721.

A review of research dealing directly or indirectly with the development of bidirectional tolerance in radiation chimeras has been made. By controlling such factors as cell dose, age of donor animal and day of cell injection, it was possible to achieve bidirectional tolerance. Attempts to reduce bidirectional tolerance in favor of increasing the graft-versus-host reaction were less successful. Hypoxic caging demonstrated a new approach to achieving bidirectional tolerance through physiological competition for growth. Graft-versus-host reactions have a lower growth priority than marrow regeneration or erythropoietic hyperplasia. Study of pathologic processes, immunologic capability and the biochemical lesions in radiation chimeras all lead to new ideas that involve bidirectional tolerance. The investigations on dose rate in radiation suppression of the immune response and on LD_{50} (30- to 90-day) values after injection of different numbers of marrow cells all have a bearing on control of the host-versus-graft response and therefore are important in understanding bidirectional tolerance. (auth)

50393 ALLERGIYA I RADIATSIYA. (Allergy and Radiation). Klemparskaya, N. N.; L'vitsyna, G. M.; Shal'nova, G. A. Moscow, Izdatel'stvo Meditsina, 1968. 280p.

A review of the literature and of the author's investigations regarding allergenic processes that were incited by the introduction of foreign proteins and microbes into irradiated organisms is presented. The possibility of the development of nonspecific allergies to microbes following irradiation without contact with the given form of allergen is described. Proof of the competitive relations between the action of irradiation and by sensitization heterologous allergens is given. Most of the questions about autoallergies in irradiated organism are clarified. The importance of the autoimmune reactions for the many areas of medicine, especially the properties of antigens and antibodies, and the contemporary methods of finding autoallergenic states are considered. Data concerning the development of autoallergies following the medical application of radiation and following the action of radioisotopes are given. It was shown that autoimmune reactions emerge after the introduction of microbial vaccine. Contemporary data concerning the role of autosensitization in radiation disease are examined and an appraisal of the action of therapeutic and prophylactic methods from the point of view of desensitizing effectiveness was conducted. Data concerning the possibility of using competitions between allergenic phenomena for medical treatment of many autoimmunity illnesses are given. The book contains graphic material and a vast amount of literature. It is of interest to all physicians and investigators operating in the field of radiobiology and allergenic phenomena. (tr-auth)

Ecology

Refer also to abstracts 49748, 49966, 50161, 50468, 50586, and 50926.

50394 (BMI-171-120) SEA OTTER SURVEYS, AMCHITKA ISLAND, ALASKA, AUGUST 27-OCTOBER 6, 1968. Amchitka Bioenvironmental Program. Spencer, David L. (Bureau of Sport Fisheries and Wildlife, Washington, D. C.). Aug. 21, 1969. Contract AT(26-1)-171. 6p. Dep. CFSTI.

For Battelle Memorial Inst., Columbus, Ohio.

A Sea Otter Conference was held at Battelle's Columbus Laboratories November 7, 1967, with representatives from Battelle-Columbus, U. S. Atomic Energy Commission Nevada Operations Office, Alaska Department of Fish and Game, and the U. S. Bureau of Sport Fisheries and Wildlife. The objective of the meeting was to establish a mutually acceptable method for assessing the prompt and long-range effects, if any, of a test event at Amchitka on the sea otter population of the Island. One of the four recommendations resulting from the conference was that for conducting annual aerial population surveys under optimum counting conditions. This report covers the first of these annual surveys made during the fall of 1968. (auth)

50395 (BNWL-1051(Pt.2), pp 14-17) RADIONUCLIDE DISTRIBUTION IN THE ALASKAN ARCTIC ECOSYSTEM. Jenkins, C. E.; Hanson, W. C. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Eighteen γ-emitting natural and artificial radionuclides were measured in the Arctic biosphere. The comparison of the accumulation of radionuclides in plant and animal tissues shows distinct variations and differences in the behavior of these individual radioelements. Generally, retention of these radionuclides was found to be location and species dependent in lichen and sex and age dependent in caribou. (auth)

50396 (BNWL-1051(Pt.2), pp 44-9) RADIONUCLIDE CONCENTRATIONS IN COLUMBIA RIVER ESTUARINE ORGANISMS. Robertson, D. E.; Forster, W. O.; Renfro, W. C. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The radionuclide content of a wide variety of Columbia River estuarine organisms was measured. These radionuclides, mainly neutron activation products originating from the Hanford reactors, included ^{40}K, ^{46}Sc, ^{51}Cr, ^{54}Mn, ^{60}Co, ^{65}Zn, $^{95}Zr-Nb$, ^{124}Sb, ^{137}Cs, ^{226}Ra, and ^{228}Th. Zinc-65 was the most abundant radionuclide in all organisms. Chromium-51, that is by far the most abundant radionuclide in the water, was detected in only one sample of copepods. Essentially all trophic levels of organisms were analyzed, thus providing a better understanding of the behavior and fate of radionuclides in the estuarine and adjacent Pacific Ocean food chain. (auth)

50397 (CONF-671135-, pp 143-8) SOIL-PLANT RELATIONSHIPS OF RADIOACTIVE NUCLIDES IN FALLOUT. Reitemeier, R. F. (Atomic Energy Commission, Washington, D. C.).

The uptake of radioisotopes from soil by food crops in a long-term postattack period was considered. Only several fission products were considered to be sufficiently abundant and biologically available. Cesium-137 was considered the most abundant; ^{90}Sr, second. Strontium-90 and its daughter ^{90}Y and $^{137}Cs-^{137}Ba$ would account for most of the biologically available isotopes in the soil. Other fission products that would be present in great abundance were $^{144}Ce-^{144}Pr$, $^{106}Ru-^{106}Rh$, ^{147}Pm, and ^{125}Sb; this group of isotopes which is only slightly available to plants was not considered to be too important. A detailed discussion of ^{90}Sr and ^{137}Cs metabolism by plants is then presented. (C.O.)

50398 (CONF-671135-, pp 149-67) MOVEMENT OF ^{137}Cs BY RUNOFF, EROSION, AND INFILTRATION FROM A SOIL UNDER DIFFERENT COVER CONDITIONS. Tamura, Tsuneo (Oak Ridge National Lab., Tenn.).

In a two-year study, it was found that ^{137}Cs loss by runoff and erosion was significant, particularly in exposed bare-soil areas. In such conditions with an erosion loss of 23 tons per acre, 43% of applied Cs was lost. In vegetation-covered plots, runoff and erosion losses of Cs occurred primarily in the initial stages following application from washoff at a rate approximately 10 times that expected from soil loss alone. In the first year of the study, when ^{137}Cs was initially on the vegetation, loss of one ton per acre of soil resulted in a 20% Cs loss. Empirical logarithmic equations for the dependency of cesium loss on soil loss are given. It was found that considerable redistribution within a plot could occur and that cesium uptake by new vegetation represented a small part of the total applied. Most of the applied cesium that was not eroded was found in the top 3-cm layer of soil. (C.O.)

50399 (RLO-2047-5, App. G) ACCUMULATION OF ^{51}Cr BY THE BEACH DIATOM, CHAETOCERUS ARMATUM. (Washington Univ., Seattle. Lab. of Radiation Ecology). 2p.

To a culture of about 60 ml of Chaetocerus armatum containing no, or very little, particulate matter, one microcurie of ^{51}Cr was added. The culture was incubated at 18°C and samples taken at three, six, and twelve days. Results indicate that at least 90% of the ^{51}Cr is taken up in ionic form. (H.B.G.)

50400 (PRNC-129) THE RAIN FOREST PROJECT. Annual Report. Jordan, Carl F.; Drewry, George E. (Puerto Rico Univ., [Rio Piedras]). June 1969. Contract AT(40-1)-1833. 144p. Dep. CFSTI.

Separate abstracts were prepared on three sections of this report. (C.H.)

For abstracts of individual sections see: 50401-50403.

50401 (PRNC-129, pp 1-86) SECTION I. Jordan, Carl F. (Puerto Rico Univ., [Rio Piedras]).

Ecological studies of a tropical rain forest located at an elevation of 1500 ft on the side of El Yunque mountain in Eastern Puerto Rico are reported. Contents of Ca, Cu, Fe, K, Mg, Mn, Na, and P in various compartments of the ecosystem were determined from contents in leaves, bark, roots, litter, organic matter in the forest

and biomass of the soil. Rates of movement of each element were related to rainfall and season. Fallout distribution in tropical rain forest systems was studied in terms of species, site, canopy, presence of epiphylls on leaves; ^{144}Ce, ^{137}Cs, and ^{95}Zr were used as tracers. The movements of injected ^{137}Cs, ^{54}Mn, ^{86}Rb, and ^{85}Sr through selected species of trees (Matayba domingensis and Dacryodes excelsa) were also measured at various times, and activity in the surrounding soil was determined. Tritium transport was studied in a plot to which tritiated water was applied by simulated rainfall; runoff water was collected beneath the litter and at a depth of five inches in soil was also analyzed. A pulse of tritium was injected into representative trees (Dacryodes excelsa and Sloanea berteriana) and determination of the length of time required for the tritium to reach the canopy, the residence half-time of tritium in free water, and the amount of tritium bound in the leaves by photosynthesis. The quantity of tritium lost through evaporation from the soil was also measured. Measurements were made during 1966, 1967, and 1968 of all plants within a 676 square meter grid surrounding an area that was γ-irradiated in 1965 and comparisons were made for 15 common successional species with plants taken from other successional sites in the vicinity of the study area. Data are presented on the leaf fall, biomass of the successional vegetation, biomass of the mature forest, net photosynthesis in the successional area, leaf respiration of successional vegetation, gross photosynthesis of the successional area, leaf area, chlorophyll content, solar radiation in the area, and changes in the standing crop and biomass of plants during succession. (C.H.)

50402 (PRNC–129, pp 87-121) SECTION II. Drewry, George E. (Puerto Rico Univ., [Rio Piedras]).

Computer methods were developed that use information theory in studies of species diversity in the population structure in ecological communities. Applications in studies of species diversity of plants during recovery of the area following γ irradiation and in studies of insect communities in the surrounding forest are reported. Tritium was used as a tracer in studies on the mobility of insects, frogs, lizards, and snails. Zinc-65 was also used as a tracer in studies on the biology of the snail Caracolus caracolla. The role of ecological specialization in the evolution of amphibians was studied, with emphasis on the evolution of anurans in the family Bufonidae. A key to insects in the family Dolicophodiae found in the rain forest at El Verde was prepared. (C.H.)

50403 (PRNC–129, pp 122-44) SECTION III. (Puerto Rico Univ., [Rio Piedras]).

Ecosystem studies such as those of productivity and chemical element cycling require measurements of the quantity of leaves in the canopy. This quantity is expressed as leaf area index. A method of measuring leaf area index is described that is based on measurements of the quantity of light on the forest floor. The role of epiphytic plants in the fixation of atmospheric nitrogen in a tropical rain forest was studied using ^{15}N as a tracer. The effects of gamma radiation on number of nests of termites (Nasutitermes costalis) in an area were studied three years following irradiation. (C.H.)

50404 (UCSD–10-P-20-50(Pt.1)) RESEARCH ON THE MARINE FOOD CHAIN. PROGRESS REPORT, JULY 1968–JUNE 1969. PART I. INTRODUCTION AND ACCOUNT OF WORK IN PROGRESS. Strickland, John D. H. (California Univ., La Jolla. Inst. of Marine Resources). Contract AT(11-1)-Gen-10. 73p. (IMR–69-9(Pt.1)). Dep. CFSTI.

Progress is reported on: automatic methods of analysis, laboratory studies on the significance of ATP and DNA measurements as biomass indicators, studies of oxygen consumption in the oceans, nitrification in marine ecology, analysis of surface-active organic material concentrated at the sea surface, natural radiocarbon activity of marine zooplankton and fishes, dissolved organic carbon in deep sea, carbon isotopes in marine organisms, utilization of DDT by marine bacteria, collection of Pacific coastal phytoplankton, vitamins in marine ecology, chemical composition of phytoplankton cells, effects on phytoplankton of long storage periods in dark, in-vivo chlorophyll a fluorescence, rates of ingestion and growth of Calanus helgolandicus as functions of concentration of food, and feeding studies of some adult copepods. (M.C.G.)

50405 RESPONSE OF MARCHANTIA POLYMORPHA L. TO CHRONIC GAMMA RADIATION UNDER NATURAL CONDITIONS. Sarosiek, J.; Wozakowska-Natkaniec, H. (Wroclaw Univ.). Acta Soc. Bot. Pol., 36: 187-97(1967).

The effects of natural chronic radiation on the ecology and development of populations of Marchantia polymorpha were studied. Eleven areas in the Sudety Mountains with various degrees of radioactivity were investigated during the vegetive seasons in 1964 and 1965. The radioactivity of the ground ranged within 0.20 to 1.48 mR/hr (γ radiation). The highest radioactivity was in the early spring and lowest in the summer. In areas where the radioactivity ranged within 0.13 to 0.18 mR/hr no response was detected in natural M. polymorpha populations. Where the intensity was 0.76 to 0.91 mR/hr there was a stimulation of M. polymorpha growth. Thalli were three times larger, growth and production of gemmae were more intense, but sexual development was inhibited. Within the radiometric anomaly where the intensity of radiation was 0.74 to 0.96 mR/hr an effect was noted on the ecological association of Mo polymorpha with other Bryophyta. The number of species normally associated decreased with increasing radiation intensity until only M. polymorpha was observed at the highest intensities. (M.M.B.)

50406 HUMAN ECOLOGY OF NORTHWESTERN COLOMBIA (THE CHOCO). McBryde, F. Webster (Battelle Memorial Inst., Columbus, Ohio); Costales, Alfredo S. Bioscience, 19: 432-5 (May 1969).

Population studies in northwestern Colombia were made as part of a bioenvironmental survey for selection of a possible route for a sea-level canal to be excavated with nuclear explosives. Three municipios of the departamento of El Choco, Colombia, will be affected by canal construction if it is decided to use Interoceanic Route No. 25. These are Riosucio, Acandi, and Jurado, and are included in the demographic study reported. They comprise 24 corregimientos, having 11,972 Km^2 area, and a total population of 16,763, some concentrated in small villages, but most dispersed through the jungles and marshlands. About 5% of the population was studied intensively by the human ecology team. Land resources, agricultural practices, consumption of various foods, and other data were determined. (BBB)

50407 COMPOSITIONAL ANALYSIS OF SELECTED SECOND-GROWTH SPECIES FROM LOWLAND GUATEMALA AND PANAMA. Snedaker, Samuel C.; Gamble, John F. (Univ. of Florida, Gainesville). Bioscience, 19: 536-8 (June 1969).

Mineral contents of agricultural products in the region of the proposed sea-level canal to be excavated by nuclear explosives were determined as part of the bioenvironmental survey of possible implications of fallout radionuclide contamination. The subsistence agriculture along the proposed sea-level canal routes in Panama and Colombia, and a study area in eastern Guatemala, is commonly called shifting agriculture and exists in two forms: slash-burn and slash-mulch. Both forms involve intervening fallow periods between cropping sequences, and the duration of the fallow is determined by an interaction of environmental and cultural factors. In a study of the shifting agriculture cycle, compositional analysis was made of the second-growth fallow vegetation. The quantity of mineral nutrients released to the soil when the fallow is cut and burned (or mulched) preparatory to cropping is a function of the floristic composition as it changes with age. As a part of the agricultural-ecology study, samples of second-growth foliage and soils were collected in Panama and analyzed to determine the concentrations of 11 elements. These data will be used in making preliminary estimates of the quantities of radionuclides that could be accumulated by second-growth vegetation during the period of nuclear excavation and thus become available for uptake by postexcavation crops planted in the same fields. The data are presented in tables which represent a compilation of the results of four independent samplings and analyses. The data show a marked variation in mineral nutrient concentrations, both within and among species. The high Mg concentrations in the Guatemala tissue analysis reflect the unusually high Mg : Ca ratio in the soil. (BBB)

Genetics and Cytogenetics

Refer also to abstracts 50331, 50332, 50334, 50399, 50823, 50878, 50925, 50929, 50942, 50945, 50955, and 50958.

50408 (BNL–13853) PREDICTED CONTROL BY THE GENETIC CODE OF DIFFERENCES IN PHENOTYPIC EXPRESSION OF POINT-MUTATIONS. Holm, G. (Brookhaven National Lab., Upton, N. Y.). [1969]. 15p. (SM–121/37). Dep. CESTI.

A review of recent literature on the effects of amino acid exchange in the protein molecule on phenotypic expression of spontaneous and induced point mutations is presented. The importance of the genetic code in controlling the amount and type of yield of amino acids from each of the eleven exchange groups, and thus over differences in phenotypic expression of point mutations, is emphasized. The significance of the frequency of DNA codons in the gene in relation to the genetic code is discussed. The distribution of transitions and transversions over the eleven groups of

amino acid exchanges is described. The effect of x rays on transitions and transversions is discussed. It is proposed that the genetic code controls differences in phenotypic expression of point mutations after use of different base-specific mutagens, and under certain circumstances also after use of base non-specific mutagens. (H.L.W.)

50409 (COO-1645-3) MUTAGENESIS OF ENTEROVIRUSES BY GAMMA RAYS. Final Technical Report, September 1, 1966-August 31, 1969. Cliver, Dean O. (Wisconsin Univ., Madison. Food Research Inst.). Contract AT(11-1)-1645. 22p. Dep. CFSTI.

An investigation was conducted to determine whether pasteurizing doses (500,000 rad) of irradiation are likely to induce genetic changes of potential public health significance in viruses. Laboratory tests were devised or adapted to measure properties of the viruses which were thought to reflect virulence, host range, tissue tropism, and antigenic specificity. Virus tests and titrations were performed using rhesus monkey kidney cell cultures. Viruses used were poliovirus type 1, Coxsackie virus type A-9, Coxsackie virus type B-2, and ECHO virus type 6. Tests for genetic markers correlated with virulence are described. Swine kidney cell cultures comprised the test system for studying species specificity. Irradiation of poliovirus with doses of 0.25 and 0.5 Mrad caused 36% and 99% inactivation, respectively. Preliminary tests gave no indication of antigenic variants in irradiated poliovirus suspensions. Irradiation of Coxsackie A-9 with doses of 0.25 and 0.5 Mrad caused 80% and 95% inactivation in initial tests. Antigenic variations thought to have occurred in Coxsackie A-9 as a result of irradiation probably lack public health significance. Nearly all Coxsackie A-9 virus after irradiation remained identifiable by the neutralization test. This is interpreted to mean that an individual who has acquired active immunity to the virus would probably be immune to these variants as well. After the Coxsackie B-2 virus was irradiated with doses of 0.25 and 0.5 Mrad the virus showed no alterations in virulence markers in a limited series of tests. Reductions of 73% and 99% in the titer of ECHO virus suspensions occurred following doses of 0.25 and 0.5 Mrad. No definitive change in the virulence markers was noted following irradiation. (H.L.W.)

50410 (COO-1748-5) TOTAL RADIATION-INDUCED GENETIC DAMAGE IN ENTIRE GENOMES OF DROSOPHILA MELANOGASTER. Technical Progress Report. Abrahamson, Seymour (Wisconsin Univ., Madison). [nd]. Contract AT(11-1)-1748. 12p. Dep. CFSTI.

Male flies were x-irradiated with doses up to 4000 R. A graph is presented to show effects of increasing doses on sperm with regard to dominant lethals, total damage, and inherited damage. It was estimated that a dose of 2,000 R resulted in 56% damaged genomes and 44% undamaged genomes; a dose of 4000 R resulted in 63.2% damaged genomes. The increase in dominant lethals was essentially linear, but at 2000 R, 28.2% of sperm transmit genetic damage, while at 4000 R only 10.2% transmit damage. In the 4000 R series of irradiations for the total genetic damage study both X-bearing and Y-bearing genomes were studied; it was found that Y autosome translocations were more frequent than X autosome translocations. For studies on insertional translocations and replicating instabilities a scheme was devised that would screen for viable, fertile translocations between the X and any autosome. The effects of EMS and x radiation on the frequency of translocation mosaics were studied. (H.L.W.)

50411 (NYO-2043-195, pp 8-22) COMPARATIVE STUDIES ON THE MUTATION FREQUENCY AND GENETIC BEHAVIOR OF THE MUTATIONS INDUCED BY ACUTE AND CHRONIC GAMMA IRRADIATION AND ETHYL METHANESULFONATE IN THE COMMON BEAN. Moh, C. C.; Nanne, H. (Inter-American Inst. of Agricultural Sciences, Turrialba (Costa Rica)).

Analysis of 100 mutant lines of the common black bean induced by acute γ irradiation of seeds, 195 mutant lines induced by plant irradiation, and 215 mutant lines induced by EMS treatment of seed showed there was no significant difference in the proportion of chlorophyll to morphological mutations, the percentage of mutant lines segregating in aberrant genetic ratios, or the mean percentage of the mutants segregated by mutant lines following irradiation or EMS treatment of seed. In plants that were exposed to chronic γ irradiation for the whole life cycle, the proportion of chlorophyll to morphological mutants and the percentage of mutant lines segregating in aberrant genetic ratios were significantly higher, while the mean percentage of the mutants segregated by the mutant lines was much lower. (C.H.)

50412 (NYO-2043-195, pp 22-6) REDUCED GENE TRANSMISSION AND GENOTYPIC RATIO. Moh, C. C. (Inter-American Inst. of Agricultural Sciences, Turrialba (Costa Rica)).

Calculations were made on the transmission frequencies of the normal and mutant gene through male and female gametes in mutants of black bean plants induced by γ radiation. Possible mechanisms responsible for segregation ratios are discussed. (C.H.)

50413 (NYO-2043-195, pp 27-38) INDUCTION OF SEED COAT COLOR MUTANTS IN THE COMMON BEANS. Moh, C. C. (Inter-American Inst. of Agricultural Sciences, Turrialba (Costa Rica)).

The induction of mutations for seed coat color in beans by treatment of dry seeds with EMS or exposure of seeds to acute doses of γ radiation is discussed. The mode of inheritance of seed coat color in beans is discussed. A list of induced bean mutants and their genetic behavior and reproducibility is included. (C.H.)

50414 (NYO-2043-195, pp 62-74) THE MECHANISM CONTROLLING DWARFISM IN A RADIATION INDUCED, SINGLE GENE MUTANT OF MEXICO 80-R BEANS. (Inter-American Inst. of Agricultural Sciences, Turrialba (Costa Rica)).

A γ-radioinduced mutant for dwarfism in bean plants was found to be controlled by a single gene. Results are reported from an attempt to identify the mechanism controlling dwarfism. (C.H.)

50415 (NYO-3314-15) GENETIC CONTROL OF AGING AND RADIATION-INDUCED LIFE-SHORTENING IN MICE. Final Progress Report, October 1, 1968-August 15, 1969. Yuhas, John M. (Jackson Lab., Bar Harbor, Maine). Aug. 15, 1969. Contract AT(30-1)-3314. 80p. Dep. CFSTI.

Various aspects of the somatic mutation theory of genetic control of aging and radioinduced life shortening are reviewed. Rates of aging in inbred and hybrid populations were estimated, and tables are presented to show mean age at death and gross pathology at death. Experimental groups of mice were exposed to 0, 250, and 450 R of x radiation at 120 ± 4 days of age. After exposure the mice were returned to their pens to live out their normal life span. Accumulation of somatic mutations with age was determined for liver, cornea, spermatozoa, and ova. Chromosome aberrations in the liver and cornea were observed and recorded, and spermatozoa and ova were tested for dominant lethal mutations. Tables are presented to show incidence of lung, liver, mammary, and ovarian cancer, and leukemia at death as a function of radiation dose given at 120 days. Studies were conducted on genetic control of the following: longevity; rate of aging; resistance to age dependent accumulation of somatic mutations; and resistance to mutation induction by radiation. Studies on radioinduced life-shortening showed that life-shortening does not correlate with the rates of somatic mutation accumulation or the rates of aging. Other studies were conducted on effects of age and genotype on radiation resistance of the central nervous system, gastrointestinal system, and the hematopoietic system. Effects of age, genotype, and radiation on the gross composition of the brain were investigated. (H.L.W.)

50416 (PHS-999-RH-33, pp 23-32) CYTOGENETIC EFFECTS OF IRRADIATION. Abbatt, John D. (Department of National Health and Welfare, Ottawa (Ontario). Radiation Protection Div.).

The types of chromosome aberrations were outlined and cytogenetic radiation studies in man were summarized. The clinical studies were mainly diagnostic, while the population studies dealt with occupational radiation exposure, exposure to radiotherapeutic procedures, fallout and nuclear explosions. The significance of cytogenetic changes and their relation to mutagenesis were discussed. The application of the cytogenetic technique to human epidemiological studies was considered essential for obtaining somatic genetic information. An example of the study of lung diseases in hard-rock miners was given. (F.M.M.)

50417 (PHS-999-RH-33, pp 51-3) GENETIC HAZARDS OF IONIZING RADIATION. Schull, William J. (Michigan Univ., Ann Arbor. Dept. of Human Genetics).

A general discussion of the genetic hazards of radiation to man is presented. It was stated that the genetic damage that accrues to a population from exposure to ionizing radiation will be directly proportional to that exposure; a qualitative assessment of the risks (chromosome damage and mutations) to man is possible, but a meaningful quantitative appraisal continues to elude man. It was concluded that the minimal doubling dose for mutations in man is less than 50 R for radiation of the type emitted by an atomic bombing and for mutations of the kind resulting in early death in the first post-bomb generation. (C.O.)

50418 (RLO-1924-25) [STUDIES ON THE GENETIC CONTROL OF MEIOSIS IN DROSOPHILA MELANOGASTER]. Final Report. Suzuki, David T. (British Columbia Univ., Vancouver. Dept. of Zoology). July 31, 1969. 10p. Dep. CFSTI.

Chromosome breakage, nondisjunctions, and mutations were induced by mitomycin C and x radiation. The interchromosomal effects of genetic changes on crossing over were summarized

and a model proposed to explain the data. It was suggested that termination of crossing over is signalled by the completion of a specific amount of total pairing. A model was proposed to explain the low frequency of crossing over normally occurring in regions adjacent to proximal heterochromatin and the preferential induction of exchange in these segments by recombinagenic agents. The model proposes that normally, at the time of crossing over, heterochromatin is genetically active, a condition which interferes with the synapsis necessary for crossing over to occur. Inhibition of this activity permits synapsis. A component of DNA, composed of deoxyadenylate and deoxythymidylate, in cells of the crab, Cancer productus, was investigated. A model for chromosome coiling patterns based on the need for unwinding of DNA strands in multistranded chromosomes was derived. Recoverability and properties of temperature-sensitive mutants were studied and results are discussed. (H.L.W.)

50419 (RLO-2045-3) UV MICROBEAM STUDIES ON MITOSIS. Progress Report. Bajer, Andrew S. (Oregon Univ., Eugene. Dept. of Biology). Apr. 30, 1969. Contract AT(45-1)-2045. 6p. Dep. CFSTI.

The effects of irradiation with a uv microbeam on the movement of chromosomes in vitro and the mitotic fine structure of endosperm cells of Haemanthus katherinae are reported. The behavior of the chromosomes after irradiation was recorded with time-lapse photography. The cells were then fixed (30 sec to 3 min) and sectioned in preparation for fine structure observations. The chromosome movements after different radiation doses are described. In some cases chromosomes were observed moving backwards. The fine structure of cells irradiated in different stages of anaphase is described with emphasis on the appearance of microtubules. (M.M.B.)

50420 A COMPARISON OF THE FREQUENCY AND SPECTRUM OF MUTATIONS INDUCED BY GAMMA RAYS AND EMS IN WHEAT. Varughese, G. (CIMMYT, Mexico City); Swaminathan, M. S. Indian J. Genet. Plant Breed., 28: 158-65(1968).

The mutation spectrum and frequency induced by ^{60}Co γ rays and ethyl methane sulfonate (EMS) in Sonora 64, a hexaploid spring wheat, are compared. Doses of 20 and 30 KR of γ rays were given dry, dormant seeds having 12% moisture. Seeds presoaked in distilled water for 14 hr were given 8-hr (EMS 1/100 and EMS 1/200) as well as 16-hr (EMS 1/200 and EMS 1/400) treatments in buffered solution at pH 7 and 30°C. Studies of M_1 generations showed that with both mutagens, within the dose range tested, gave a clear correlation between the dose and the survival percentage. A high frequency of chlorophyll chimeras in the form of white or yellow streaks of varying degrees was observed after EMS treatments, but not with γ-ray treatments. However, these chimeras did not breed true in the M_2 generation. Radiation treatment produced a high degree of mutation at the Q locus (speltoids, compactoids, subcompactoids, and square heads). This is because wheat can tolerate chromosome structural changes, particularly deletions, and irradiation is known to bring about such changes. However, chimeras simulating sphaerococcum were observed only after EMS treatments. Chlorophyll mutation frequencies in different treatments calculated in terms of the percentage of M_2 families segregating, percentage of mutations in M_1 plant families, and percentage of mutant seedlings in M_2 population are tabulated. As high as 65.45% of the families segregating or 156.36% of mutations were observed in treatment with 1/100 EMS, while the maximum obtained with radiation was only 1.01%. When the relative proportions of various mutants recovered were pooled for different doses of EMS and γ rays, it was seen that EMS could induce nearly 92% of the total spectrum, while the radiation treatment could produce only 50%. Mutants like accordion ear, irregular ear, dwarf waxless apical sterile, and internode bending were recorded for the first time in wheat, all being induced by EMS. Almost 87% of the mutations induced by radiation was contributed by Q mutations (70.40%) and dwarfs (16.40%), while the spectrum was wide with EMS. The probable mode of action of EMS is discussed. It is suggested that in polyploid crops, chemical mutagens like EMS may prove more adventageous than physical mutagens for the induction of qualitative changes. (BBB)

50421 MUTAGENIC ACTION OF PROFLAVINE ON E. COLI K12, E. COLI B, AND RADIORESISTANT MUTANTS. Zampieri, A. (Univ., Milan). G. Microbiol., 15: 131-6(1967).

It is shown that the rate of mutation induction by proflavine is affected by repair mechanisms which take place in radiation-resistant mutants of Escherichia coli B. Bacterial strains used were: E. coli B lac$^-$ and K12 W 1895 lac,$^-$ lactose-negative mutants obtained using uv radiation as a mutagen. Radiation-resistant mutants of E. coli B lac$^-$ (B UV^r lac$^-$) were isolated after exposure to nitrosoguanidine. Inactivation with proflavine in visible light of E. coli 1895 lac$^-$ and its uv-resistant mutant showed that both were slightly more resistant than E. coli B Lac$^-$ to treatment with proflavine. The number of the Lac$^+$ revertants/10^8 surviving cells induced after treatment with proflavine was determined as a function of fraction of survival. The rate of mutations was exponential with all the Lac$^-$ strains. The relative efficiency of mutagenesis determined from the slope of the curve of the induced Lac$^+$ revertants was 2.3 for E. coli B Lac$^-$ when compared with E. coli B Lac$^-$ uv resistant, and 2.7 when compared with E. coli 1895 Lac$^-$. E. coli B and its derivative E. coli S lack the K-type reactivation of uv lesions and they appear more sensitive than E. coli K12 and E. coli B/r to radiomimetic compounds. Since a cross-resistance relation has been reported between uv radiation and radiomimetic agents, uv-resistant strains should be less mutable than uv-sensitive strains to radiomimetic agents. Most of the lesions induced by these agents in DNA can be restored by a repair mechanism present in radiation-resistant cells. On the contrary, radiation-sensitive cells lacking this mechanism of reactivation may retain unrepaired lesions resulting in a greater mutability. Proflavine is exceptional among radiomimetic agents in that radioresistant and radiosensitive strains are equally sensitive to it. (BBB)

50422 SPECTRUM OF CHROMOSOME ABERRATIONS IN CHEMICAL PROTECTION AGAINST GAMMA-RADIATION IN BARLEY. Zosimovich, V. P.; Levenko, B. O. (Inst. of Microbiology and Virology, Kiev). Dopov. Akad. Nauk Ukr. RSR, Ser. B, No. 7, 656-8(July 1969). (In Ukrainian).

Seeds of spring barley var. Nosovsky 2 were soaked in 0.005 and 0.05 M solutions of thiourine, cysteine, and ferric chloride for 18 hr, then dried for two days and irradiated with 10 and 20 kR doses of γ rays. The spectrum of chromosome aberrations in metaphase of meristematic tissue of seedlings was studied. It is shown that such treatment decreased frequency of certain types of chromosome rearrangement. At a 10 kR dose the frequency of double bridges and double fragments significantly decreased. (auth)

50423 MUTAGENIC EFFECT OF ULTRAVIOLET RADIATION ON THE NON-ACID-FAST STRAIN OF MYCOBACTERIUM PHLEI. Konicek, J.; Malek, I. (Inst. of Microbiology, Prague). Folia Microbiol. (Prague), 13: 282-7(1968).

The mutability of the PA strain of M. phlei was examined after induction of auxotrophic mutants of streptomycin (STM) and viomycin (VM) resistant mutants, by uv irradiation. A total of 30 auxotrophic mutants was isolated, most of them amino acid-dependent, five-purine-dependent, and one uracil-dependent. To induce the mutants higher uv doses had to be used so that the survival of cells in the original suspension would not exceed a few per cent. For further genetic work use can be made of eight auxotrophic mutants (PN try$^-$ura$^-$, PN arg$^-$ura$^-$, PN ileu$^-$val$^-$, PN ileu$^-$, PN leu$^-$, PN lys$^-$, PN lys$^-$VM^r, PN val$^-$); these showed a low frequency of spontaneous reversions. No spontaneous autotrophic mutants were found. The frequency of STM- and VM-resistant mutants was increased upon uv irradiation, a postirradiation incubation in a liquid medium without the drug being essential for their phenotypic expression. The highest increase of the number of these mutants was attained after 48-hr postirradiation incubation and the same frequency increase was found in a complete or a minimal liquid medium. The frequency of spontaneous STM-resistant mutants from 5.8×10^{-6} to 8.8×10^{-6} and of VM-resistant between 3.1×10^{-6} and 4.1×10^{-6}. The highest frequency of induced STM-resistant mutants was between 3.0×10^{-5} and 9.3×10^{-5} and of VM-resistant mutants between 1.1×10^{-4} and 2.2×10^{-4}. (BBB)

50424 SOME PROBLEMS OF EXPERIMENTAL MUTAGENESIS IN CORN. (RADIATION AND CHEMICAL MUTAGENS). Lysikov, V. N. (Frunze Agricultural Inst., Kishinev, USSR). Sel'skokhoz. Biol., 1: 783-9(1966). (In Russian).

Experiments initiated in 1955 involved a selective-genetic utilization of radiation and chemical methods toward the development of new varieties of corn. Corn seeds were irradiated with β rays, pollen was exposed to β rays, γ rays, and neutrons; partially developed panicles were treated with γ rays and exposed to internal radiation by ^{32}P or ^{35}S. In addition, the seeds and unripe generative organs of corn were chemically treated with ethyleneimine, or with diethylsulfate, dimethylsulfate, 1,4-bisdiazoacetylbutane, nitrosoethylurea, or nitrosomethylurea. The following methods showed the best results: irradiation of partially developed corn panicles with γ-ray doses of 1100 to 1200 R 4 to 6 days prior to the efflorescence of pollen; and a 24-hr soaking of seeds in a solution of the three mutagens ethylenimine, diethylsulfate, or 1,4-bisdiazoacetylbutane. New varieties of corn (1 to 3% yield) appeared in the 2nd and 3rd generations. Although 52 to 86% of the new hybrids were initially inferior to the control plants, some of the subgroups later developed distinct corn varieties, and produced 14.3% more seeds per plant than control plants, thus increasing the yield by more than 50% or 45.4 zentner/hectar. Chemical mutagenesis appeared more promising. (BBB)

50425 LINKAGE STUDIES IN PISUM. VIII. GENE SYMBOLIZATION OF 15 CHLOROTICA MUTANTS. Blixt, S. (Weibullsholm Plant Breeding Inst., Landskrona, Sweden). Agri Hort. Genet., 26: 82-7(1968).

Chlorotic mutants induced by x radiation, neutrons, ethylenimine, and ethylene oxide were studied. The chlorotic mutants, i.e., light-green forms usually viable but deficient in chlorophyll, were subjected to diallel crosses to establish locus identity among the 17 mutants. Line 5042, a mutant denoted chlorotic R_3 originated from x-ray treatment of the Weitor variety with 9 Krad. It is characterized by light green color, the tip always remaining light green while older parts progressively turn darker in color. Line 5045 also originated from x-ray treatment of the Weitor variety. Line 5134 was a neutron-induced mutant from the Weitor variety, treated with 450 rep. Line 5135 was from the same neutron-treatment as line 5134, but originating from a different X_1 plant. Line 5326 and line 5129 originated from the same x-ray treatment, i.e., 5 Krad. The remaining mutants were chemically induced. Among the 17 chlorotic mutations crossed diallelly to establish locus identity, it was found that 15 different loci were involved. These 15 loci were given gene symbols, from Chi2 to Chi16. Two mutants in locus chi3 and two in locus chi5 were found, the remaining ones were single, one mutant being found for each locus. (BBB)

50426 LINKAGE STUDIES IN PISUM. IX. LINKAGE OF THE GENE CHI5 IN CHROMOSOME II. Blixt, S. (Weibullsholm Plant Breeding Inst., Landskrona, Sweden). Agri Hort. Genet., 26: 88-99(1968).

Neutron and x-ray mutants induced in peas resulting in chlorotic forms (light-green variants) were studied to establish the linkage of the Chi5 gene. This gene that determines chlorophyll deficiency of the chlorotic type was found to be linked with genes in chromosome II, OH and S. The gene determining curved pods in line 851 was found not to be Cp but most probably the gene Cpa, and it was linked with Chi5. For the genes investigated, a map of chromosome II is shown. The possibility of a translocation II/V seems unlikely. The exact position of the gene Mifo in relation to K, Wb, and S is being further investigated. The most probable localization is that the genes Chi5 and Cpa are situtated outside the gene OH. This could explain the lack of clear linkages with the other genes of chromosome II segregating, as the distance to the nearest other gene may be long enough to give almost free recombination. Chromosome II would then be considerably lengthened. (BBB)

50427 THE PERSISTENCY IN EXPERIMENTAL POPULATIONS OF SECOND CHROMOSOME RECESSIVE LETHALS OBTAINED AFTER IRRADIATION OF SPERMATOGONIA AND SPERMATOZOA IN DROSOPHILA MELANOGASTER. Ytterborn, Karl H. (Univ., Stockholm). Hereditas, 60: 33-71(1968).

Altogether 96 lethal chromosomes were collected from progeny after a 900R x irradiation of either adult ♂♂ or 17-hr-old larvae and kept balanced against the Cy L chromosome. Of these, 86 were each tested in one population, at the tenth generation, to see how the individual lethals affected the selective value of the heterozygotes. Fifty-two lethals decreased heterozygote fitness (negative lethals) and 34 increased it (positive lethals). These latter lethals showed overdominance at the tenth generation, probably due to changes in genetic background. The frequency of positive lethals was lowest in the spermatozoa series, intermediate among lethals from irradiated spermatogonia in larvae and obtained in the mating period 0 to 3 days after eclosion, and highest in the group derived from matings 15 to 18 days after eclosion. Germinal selection affecting autosomal genes was proposed to account for these results. Mapping of positive and negative lethals showed no significant differences in their distribution. (auth)

50428 MUTATION OF ESCHERICHIA COLI K-12 MEDICATING SPHERELIKE ENVELOPES AND CHANGED TOLERANCE TO ULTRAVIOLET IRRADIATION AND SOME ANTIBIOTICS. Normark, Staffan (Univ. of Umea, Sweden). J. Bacteriol., 98: 1274-7(June 1969).

In a mutation experiment with a rough, ampicillin-resistant strain of Escherichia coli K-12, two smooth ampicillin-sensitive mutants were isolated. One of the mutants (with the envA gene) was recently described. The second mutant (strain D23) with the envB gene which has been mapped to a position close to streptomycin resistance (strA) at 64 min is described. The envB gene gives rise to spherelike cells. Electron microscopy revealed an abnormal septum formation and a circular distribution of the nuclear material. Strain D23 (with envB) showed a changed resistance to several antibiotics as well as an increased tolerance to ultraviolet irradiation. The envB gene decreased the ampicillin resistance mediated by the ampA gene (at 82 min), but no effect was found on episomally mediated penicillin resistance. (auth)

50429 UV-INDUCED LETHALITY AND MUTATION IN SYNCHRONIZED CULTURES OF USTILAGO HORDEI SPORIDIA. Hood, C. H. (Queen's Univ., Kingston, Ont.). Mutat. Res., 6: 391-400(Nov.-Dec. 1968).

The uv induction of mutation and lethality was studied in successive stages of a synchronous population of Ustilago hordei sporidia. Stages of high sensitivity are characterized by survival curves with high D_0 and low D_q values, while in resistant stages the relative values of both D_0 and D_q are reversed. The mutation rates are low during periods of increasing resistance and high during periods of increasing sensitivity. Variations in the stage-dependent responses to uv irradiation are attributed to differences in repair activity in the different stages of the cell cycle. It is concluded that the interactive influences between synthetic activities and repair processes affect the variations in uv responses during different stages of sporidial development. (auth)

50430 SOME SYNTHETIC MULTIPLE INTERCHANGE STOCKS OF WATERMELONS INDUCED BY γ-RAYS. Shimotsuma, Minoru. Chromosome Inform. Serv., No. 8, 3-4(Dec. 1967).

An attempt was made to breed seedless watermelons by γ irradiation of dry seeds. Individuals that showed various degrees of pollen fertility in the X_1 plants were obtained. The interchange heterozygotes which had a ring of four chromosomes were self-pollinated for the selection of interchange homozygotes. The progeny resulting from self-pollination included semi-sterile plants and normal fertile ones in a 1 : 1 ratio. The semi-sterile plants were recognized, on cytological examination, to be single interchange heterozygotes involving four chromosomes in single complex. By the further crossings, the resulting progenies segregated into plants with various degrees of pollen fertility. A ring of eight and a ring of six chromosomes are multiple interchange complexes resulting from the occurrence of three interchanges involving two common chromosomes and two interchanges involving one common chromosome respectively. These were self-pollinated for the selection of interchange homozygotes. It is generally recognized that fertility decreases as the frequency of interchange increases and that the same number of chromosomes is involved. The degree of sterility is dependent on the size of the chromosome ring, e.g., a ring of six chromosomes produces a higher sterility than does two rings of four. As the chromosome number of watermelon is n = 11, the least number of interchanges required to make a ring of 22 in an interchange heterozygote, is ten. A watermelon plant with a ring of 22 chromosomes, if it is induced, will probably be completely sterile. (NSA of Japan)

50431 ON THE DETERMINATION OF ABSORBED DOSE IN HEAVY IONIZING PARTICLES. Fujii, Taro (National Inst. of Genetics, Misima, Japan). Annu. Rep. Nat. Inst. Genet. (Engl. Ed.), No. 17, 111-12(1967).

Dry F_2 seeds obtained from F_1 hybrids between a hairless mutant and the wild strain of Arabidopsis were subjected to γ rays from a ^{137}Cs source and to ^{4}He, ^{12}C, and ^{40}Ar ions from the Hilac accelerator. The experiments showed a severe killing effect of heavy ionizing particles, and also dramatically high mutation rates and marked growth inhibition. RBE for somatic mutation at 0.5% frequency was roughly estimated as 10, 35, and 5 for He, C, and Ar ions, respectively. The range of heavy ionizing particles is very short. The average seed volume was calculated roughly from the weight and measurements of length and width of the seeds to be 20.5×10^{-3} mm^3. From this calculation, it was concluded that Ar ions must be stopped within the seeds but He and C ions could penetrate and pass through seed tissue. Moreover the energy transfer varies according to the position of the range or tissue which may be seen from the Bragg curve. Further experiments on the killing efficiency of heavy ionizing particles were done. Dry seeds were irradiated with C ions in 5 different lots. Each lot received the same number of particles per cm^2, but the energies of the ions were varied for the different lots by different thickness of absorbers and lot 1 received a surface dose of 400 rad. Survival rates decreased with the increase of absorber thickness. The results suggested that the irradiation with C ions with maximum stopping power has a more severe killing effect, because the maximum of the stopping power is 6×10^3 MeV/g/cm^2 at the range of 45 mg/cm^2. That is, the RBE value of C ions should be larger than that obtained in the previous experiment for ions with maximum stopping power. (BBB)

50432 GENETIC ANALYSIS OF LON MUTANTS OF STRAIN K-12 OF ESCHERICHIA COLI. Donch, John; Greenberg, Joseph (Palo Alto Medical Research Foundation, Calif.). Mol. Gen. Genet., 103: 105-15(1968).

Following uv irradiation of Escherichia coli strain K-12, mucoid uv sensitive mutants were isolated. These were all induced to form filaments by uv irradiation, i.e., they had all the phenotypic properties of Lon mutants. These lon mutants fell into two pheno-

typic classes based on their sensitivity to uv. The gene determining uv sensitivity and mucoidy in all mutants of both Class A and Class B was cotransducible with proC. Intra-class crosses by P1 transduction yielded no uv resistant recombinants. Inter-class crosses yielded uv resistant nonmucoid recombinants, the frequency depending on the direction of the cross. The data imply two adjacent blocks in the lon region of E. coli and the order of markers in this region is probably proC tsx lon Class A lon purE Class B. (auth)

50433 SYNTHESES OF SOME MULTIPLE INTERCHANGE STRAINS OF WATERMELONS INDUCED BY γ-RAYS. Shimotsuma, Minoru (Kihara Inst. for Biological Research, Yokohama, Japan). Seiken Jiho, No. 20, 47-53(Dec. 1968).

An attempt was made to breed seedless watermelons by means of chromosomal interchanges following exposure of dry seeds of Asahi-Yamato variety to 40 kR γ rays. From cytogenetic studies of the progeny of plants 15 homozygous strains for one interchange were obtained. After many crossing experiments and analyses of meiotic configurations, several synthetic interchange strains and chromosomes in heterozygous condition were obtained. The interchange heterozygote with 8 + 6 chromosomes showed 6% pollen fertility, which was the lowest. Fruits set on the plants of this interchange heterozygote contained 50 normally developed seeds on an average, which roughly corresponds to pollen fertility of 6%. (auth)

50434 LINKAGE STUDIES IN PISUM. X. LINKAGE OF THE GENE CHI3. Blixt, S. (Weibullsholm Plant Breeding Inst., Landskrona, Sweden). Agri Hort. Genet., 26: 100-6(1968).

Further data concerning the linkage of the gene chi3 were studied in crosses of an x-ray-induced pea mutant (line 5048) and an ethylene oxide-induced mutant (line 5063 B). The lines 5048 and 5063 B both carried a mutation in the gene chi3. The gene chi3 is one of the many genes determining chlorophyll deficiency of chlorotica type in the pea. In the five crosses studied, both the 5048 and 5063 B lines were found to be linked to the gene A in chromosome I, with an average CrO value of 17.1 ± 0.9%. Indications of a chromosomal rearrangement, probably involving the chromosomes I and V, were found, at least in line 5063 B. (BBB)

50435 LINKAGE STUDIES IN PISUM. XIII. CONTRIBUTIONS TO THE GENE-MAP OF CHROMOSOME II. Blixt, S. (Weibullsholm Plant Breeding Inst., Landskrona, Sweden). Agri Hort. Genet., 26: 142-8(1968).

Crosses of x-ray and chemically (ethylene oxide) induced mutants of peas were used to study chromosome II, with special reference to the localization of Mifo, the gene controlling minute foveatus. The mutant lines were single-gene mutants from the variety Weitor. The genes S-Wb-K-Mifo in chromosome II were subjected to 3- and 4-point analysis to establish sequential order, which was found to be the one given above. The dihybrid combinations found in 10 crossings of Weitor X line 851, four crossings Weitor X line 1072, three crossings Witham Wonder X line 1972, one crossing Parvus X line 1072, and one crossing W 709 X line 1072 were compared with the data published by Lamprecht. The CrO values of Lamprecht were found to be lower throughout, but the relations between the genes were the same, except for Mifo. (BBB)

50436 LINKAGE STUDIES IN PISUM. XII. LINKAGE RELATIONS OF THE GENES Fr AND Fru, DETERMINING RAMIFICATION. Blixt, S. (Weibullsholm Plant Breeding Inst., Landskrona, Sweden). Agri Hort. Genet., 26: 136-41(1968).

An x-ray-induced mutant of peas was used to study linkages of the Fr and Fru genes. Line 851 was crossed with line 5045 (from x-irradiated Weitor variety) and with three other lines. The x-ray-induced mutant was of the chlorotica type (light green). Investigation of the linkage relations of the ramification genes Fr and Fru showed that one of the genes, Fr, was linked with the gene St in chromosome III (CrO value 37.7 ± 2.2%) and the other, Fru, was linked with genes in chromosome IV. The CrO values found were 28.1 ± 1.9 with Pro and 32.0 ± 2.9 with Vim. At the same time, the positions of Pro and Fru were found to be between Le and Vim, in the sequence Le-Pro-Fru-Vim. (BBB)

50437 DIEPOXYBUTANE PRETREATMENT EFFECTS ON UV-INACTIVATION AND PHOTOREACTIVATION OF SACCHAROMYCES CEREVISIAE. Kilbey, B. J. (Edinburgh Univ.). Mutat. Res., 8: 73-8(July-Aug. 1969).

Experiments are described in which the effects of diepoxybutane pretreatment on uv response were tested in a strain of yeast requiring adenine for growth. Pretreatment abolished the sigmoid character of the uv-inactivation curve and also increased its slope. The pattern of photoreactivation was also altered by pretreatment. Diepoxybutane was found to produce a lethal after-effect in this strain that could be destroyed by extended washing. Extended washing also removed the effects of diepoxybutane pretreatment on uv-inactivation and photoreactivation. The after-effect and the effect of pretreatment disappeared simultaneously. The possible significance of these findings is discussed. (auth)

50438 X-RAY EFFECTS ON M_1 EGGPLANTS. Bagramyan, S. B. Biol. Zh. Arm., 22: No. 1, 96-103(Jan. 1969). (In Armenian).

The effects of different x-ray doses on the first generation of eggplant plants are given. Anhydrous seeds of two varieties of eggplants were x-irradiated to doses of 500 R, 1000 R, 1500 R, 2000 R, and 5000 R at a dose rate of 55 R/min. The differences in the growth and development of plants and the frequency of morphological changes were studied in first generation plants. It was established that in one variety an increase of dose had stimulating effects on growth, development, and other parameters, while in the other variety it hindered these parameters. From observations on growth, development, and fertility of plants in the first generation, it was possible to make the following conclusions: different doses of x rays had a different efficiency and specificity of action on growth and development in the first generation; specificity was observed in relation to the efficiency of action of x rays; in the first generation, 22 types of changes, were obtained and from the 22 types of changes, only six were dominant, the other 16 were cytoplasmic changes. (auth)

50439 RECOMMENDATIONS FOR NEUTRON IRRADIATION OF SEEDS. pp 69-86 of Neutron Irradiation of Seeds. Vienna, International Atomic Energy Agency, 1967.

From Panel Meeting on the Use of Neutrons in Seed Irradiation, Vienna, Austria.

From Meeting on Recommendations for a Neutron Seed Irradiation Programme, Vienna, Austria. See STI/DOC-10/76; CONF-660703; CONF-661218.

Dosimetry recommendations are concerned with neutron-flux densities and spectral distribution, absorbed dose, angular neutron distribution, contaminating radiations, composition of the seeds, and design of the irradiation facility. Other recommendations are given for biological monitoring, standard irradiation facilities, radiosensitivity, mutation breeding, and establishment of an internationally coordinated program of research. (H.L.W.)

50440 SUMMARIES AND ABSTRACTS OF PAPERS. pp 3-34 of Neutron Irradiation of Seeds. Vienna, International Atomic Energy Agency, 1967.

From Panel Meeting on the Use of Neutrons in Seed Irradiation, Vienna, Austria.

From Meeting on Recommendations for a Neutron Seed Irradiation Programme, Vienna, Austria. See STI/DOC-10/76; CONF-660703; CONF-661218.

Abstracts of the following papers are presented: biological dosimetry of fast neutrons; neutrons and other ionizing radiations in the Brookhaven mutations program; neutrons in radiobiology and mutation breeding; a survey of neutron dosimetry at the Institute for Atomic Science in Agriculture, Wageningen, Netherlands; response of some seeds to unmoderated fission neutrons; activities of Euratom in radiobiological physics and dosimetry; dosimetric considerations of the neutron-seed irradiation program; towards standardization of dosimetry records; on the possibility of irradiating plant seeds in the RA Reactor, Vinca; research on the use of neutrons in seed irradiation; a radio-botanical program in sugar cane utilizing neutrons; research on the use of neutrons in seed irradiation; physical aspects of seed irradiations; modification of radiation damage during storage in seeds irradiated with thermal neutrons; genetic and cytogenetic effects of the neutron irradiation of durum wheat; factors influencing variation in RBE in irradiation of maize seeds; some effects of thermal neutrons on rice; possibilities for irradiation by neutron and gamma rays of plant seeds in Bulgaria; and fast neutron measurements with activation detectors in seed irradiations. (H.L.W.)

50441 DEVELOPMENTS TOWARDS A CO-ORDINATED PROGRAMME OF RESEARCH ON THE USE OF NEUTRONS IN SEED IRRADIATION. Konzak, C. F.; Sigurbjoernsson, B. pp 35-9 of Neutron Irradiation of Seeds. Vienna, International Atomic Energy Agency, 1967.

From Panel Meeting on the Use of Neutrons in Seed Irradiation, Vienna, Austria.

From Meeting on Recommendations for a Neutron Seed Irradiation Programme, Vienna, Austria. See STI/DOC-10/76; CONF-660703; CONF-661218.

In view of the increasing number of research reactors being constructed throughout the world, plans for internationally coordinated research on effects of neutron irradiation on seeds are considered. The proposal for the coordinated research emphasizes establishment of accurate dosimetry, problems in radiosensitivity, and production of mutations in crop plants. IAEA panel meetings were

held to make recommendations for standardization of dosimetry of protons and neutrons. Steps were taken to establish cooperation between the Division of Research and Laboratories, the Division of Life Sciences, and the Division of Nuclear Power and Reactors. Provision of a standardized seed-irradiated facility to be used in reactors is discussed. Mechanisms for formal participation in the program include a research contract and a research agreement with the Agency. (H.L.W.)

50442 EFFECTS OF AGE ON THE EFFECTS OF RADIATION ON SEEDS OF CREPIS CAPILLARIS. Batikyan, G. G.; Danielyan, A. Kh.; Martirosyan, S. N.; Karagezyan, A. S. Biol. Zh. Arm., 21: No. 11, 39-46(Nov. 1968). (In Russian).

The mutagenic effects of ionizing radiation on metabolically inactive seeds were studied. The investigations were conducted on meristematic cells of the initial rootlets of air-dried seeds of Crepis capillaris. Four groups of seeds were used (the harvest of 1963, 1964, 1965, and 1966), that were x-irradiated in the same laboratory conditions. The dose of radiation was 4000 R and the dose rate 600 R/min. Metaphase cells were analyzed. Results showed that the majority of aberrations in the seeds were of the chromosome type, yet in nonirradiated seeds the range of aberrations was changed with their age. The rearrangement reconstructions of chromosome types that were in proportion to aging disturbances turned out to be greater by this than when seeds were irradiated, i.e., in metabolically inactive seeds the probability of potential changes, induced by ionizing radiation, was increased with the age of seeds. (auth)

50443 RADIATION INDUCED GENETIC VARIABILITY IN BARLEY. Ghafoor, Abdul; Bari, G.; Rajput, M. A. (Atomic Energy Agricultural Research Centre, Tandojam, Pakistan). Nucleus (Lahore), 5: 95-100(July-Dec. 1968).

Investigations were undertaken with a view to inducing genetic variability through γ irradiation and increasing thereby the scope of selection for desirable characters in barley, Hordeum vulgare. Dormant seeds of variety C-141 were exposed to 20 kR, 25 kR, and 30 kR doses of γ radiation from a ^{60}Co source. Two hundred seeds were taken for each treatment. The irradiated seeds were sown along with the non-irradiated seeds in the field at a distance of six inches between plants and one foot between the rows for growing M1 population. Two top-most spikes were taken from each plant, and 1,250 seeds were taken per treatment at random and sown for raising the M2 population. The plant-to-plant and row-to-row distance in the M2 was kept the same as it was in the M1 population, and the normal cultural practices were followed. In the M2 population 150 plants were selected at random for detailed studies. The characters studied were days to flower, plant height, tiller number, plant yield, and 100-grain weight. The data for each character were analyzed statistically for the estimation of variance. The mean value of the irradiated population decreased in case of days to flower, plant height, 100-grain weight, and the grain yield per tiller, whereas it increased in the number of tillers per plant and also in plant yield in 30 kR treatment. It was concluded that ionizing radiations cause considerable increase in the genetic variability of quantitative characters which can be utilized effectively in crop improvement programs. (auth)

50444 CHROMOSOME CHROMATID REARRANGEMENTS RESULTING FROM THE MITOTIC CROSSING-OVER BETWEEN SISTER-CHROMATIDS IN RING CHROMOSOMES OF CREPIS CAPILLARIS. Dubinin, N. P.; Nemtseva, L. S. (Inst. of General Genetics, Moscow). Mol. Gen. Genet., 104: 331-8(Aug. 15, 1969).

All radiation-induced aberrations in dry seeds of Crepis capillaris are chromosome rearrangements. The main types of chromosome rearrangements in the above tests were asymmetrical and symmetrical exchanges, ring chromosomes and ring deletions. The majority of ring chromosomes is of a chromosome type which brings about paired rings. Fig. 1 presents the mechanism of the production of the paired rings. In a number of cases the structure of rings proved to be quite unexpected. Among middle size rings single rings proved to occur in 18.8%, among microrings –1.9% cases. Somewhat fewer are presented by pairs of rings one inside the other. The large rings present complex figures made by tangled chromatids. Two rings make one due to mitotic crossing-over between sister-chromatids (Fig. 5). Double crossing-over would lead to the exchange of part of material between two independent rings or to one ring being thrust into the other due to different strand positions in two points of the exchange. Large rings is the provision of complicated exchanges. (auth)

50445 ON A VIABLE yv MUTANT LINE OF LYCOPERSICON ESCULENTUM MILL. 3. STUDIES ON FRACTIONS OF FREE AMINO ACIDS IN LEAVES AND ANTHERS OF THE CONDINE RED VARIETY OF LYCOPERSICON ESCULENTUM AND OF THE STERILE-POLLEN MUTANTS yv^{ms} yv^{ms}. Herrmann, Falko (Institut fuer Kulturpflanzenforschung, Gatersleben, Ger.). Flora (Jena), Abt. A, 159: 40-57(1968). (In German).

An x-ray induced tomato mutant was studied. It was a yellow-leaf mutant resulting from x irradiation of seeds of the Condine Red variety. It is shown that the composition of free amino acids in the leaves and the anthers of the parent, wild-type tomato (Condine Red) differs from the composition of the male-sterile mutant yellow-virescent (yv^{ms}). In the yellow leaves of the yv^{ms} mutant the concentration of the free amino acids is higher than in the wild type, especially asparagine, glutamine, and proline. Pipecolic acid (piperidine-2-carboxylic acid) is present in the yellow leaves of the mutant, but not in the green leaves of the wild type. The occurrence of pipecolic acid in the anthers was observed in wild-type tomatoes as well as in the mutant. In the anthers of the tomato there is a much higher amount of free proline than in the leaves. Compared with the wild type, the anthers of the male-sterile mutant contain less proline. The important role of proline in the viability of pollen and the correlation between the amount of proline in the pollen and the occurrence of pollen fertility or sterility are discussed. The occurrence and role of pipecolic acid in plant metabolism is discussed. It is suggested that the occurrence of pipecolic acid is a secondary effect of mutation. (BBB)

50446 THE ISOLATION OF MUTANTS AFFECTING ASCUS DEVELOPMENT IN NEUROSPORA CRASSA AND THEIR ANALYSIS BY A ZYGOTE COMPLEMENTATION TEST. Srb, Adrian M.; Basl, Mary (Cornell Univ., Ithaca, N. Y.). Genet. Res., 13: 303-11(June 1969).

A large number of mutants that affect the morphology of the ascus of N. crassa was isolated by a screening technique that utilized the filtration principle to separate colonial type mutants from wild type. Conidia were exposed to the following mutagens: uv radiation (10- to 15-min exposure 40 cm from a Sylvania germicidal lamp), ionizing radiation (48,000 R of 220-KV x rays), β-propiolactone (0.1% solution, 15 to 17 min), ethane methane sulfonate (3%, 1 to 2 hr), dimethyl sulfate (0.1%, 10 to 12 min), and N-methyl-N^1-nitro-N-nitrosoguanidine (15 μg/ml, 2 to 2½ hr). A procedure is described for isolating abnormal ascus mutants and subjecting them to the zygote-complementation test. In relation with each other and with wild-type alleles, the mutant genes exhibited zygote dominance and recessiveness. Results of the zygote complementation test for placing the recessive mutants into functional groupings placed the mutants into 7 functional groups. Dominance relations in the developing ascus of Neurospora are discussed. (BBB)

50447 ALLELIC COMPLEMENTATION AT THE PYRIMIDINE (pγ) LOCUS OF THE CRUCIFER, ARABIDOPSIS. Li, S. L.; Redei, G. P. (Univ. of Missouri, Columbia). Genetics, 62: 281-8(June 1969).

Three temperature-sensitive alleles of the pγ locus (controlling the synthesis of 2,5-dimethyl 4-aminopyrimidine moiety of thiamine) displayed allelic complementation in two combinations. Another 24 obligate pyrimidine auxotrophs failed to complement to any detectable extent. The complementation was quantitatively assayed by plant height, weight, leaf pigment, protein and thiamine production in the hybrids as compared to the better parent. The difference between homo- and heteroallelic combinations at both 28° and 15°C was highly significant. The three temperature-sensitive alleles seemed to represent at least two complementation groups. Two x-ray mutants displayed opposite types of temperature sensitivity, an observation hard to reconcile with the view that x rays produce only gross deletions. (auth)

50448 THE GALACTOSE OPERON OF E. COLI K-12. II. A DELETION ANALYSIS OF OPERON STRUCTURE AND POLARITY. Shapiro, James A.; Adhya, Sankar L. (Hammersmith Hospital, London. Institut Pasteur, Paris. Univ. of Wisconsin, Madison). Genetics, 62: 249-64(June 1969).

A detailed genetic map of the galactose operon of E. coli K-12 was constructed by deletion mapping of mutations described in the preceding communication. Non-polar and polar mutations were located in three groups corresponding to the kinase, transferase, and epimerase structural genes. As shown previously, the order of these genes on the bacterial chromosome is K–T–E–λ prophage. Three gal$^-$ regulatory mutations all map at the λ end of the galactose operon. Comparison of map position versus polarity for nonsense mutations of the epimerase and transferase genes indicates that transcription of each gene begins at the end closest to the λ prophage. Analysis of strains carrying deletions shows that removal of the epimerase end of the galactose operon abolishes the activity of intact structural genes. Such pleiotropic negative deletions are all cis-dominant. From these results, it is concluded that the galactose operon is a negatively controlled, polarized unit of transcription and translation governed by essen-

tial and rate-limiting genetic elements located at the end of the operon closest to the λ prophage. Genetic analysis of spontaneous extreme polar mutations rules out the possibilities that they affect special regions of the operon or that they are multiple mutations or extended deletions. Comparison of map position versus polarity for these mutations shows that they exert qualitatively different polar effects from those of nonsense mutations. To account for their properties, it is suggested that these spontaneous extreme polar mutations result from the insertion of large pieces of genetic material into structural genes. In order to map the galactose operon, bacterial deletions extending between the operon and the λ prophage were isolated by a double selection technique. The deletion map of the λ prophage obtained with these mutants is consistent with that determined by other methods. The existence of a set of coherent deletions between the λ prophage and galactose operon supports the Campbell model of prophage integration by linear insertion into the bacterial chromosome. (auth)

50449 STUDIES ON ITACONIC AND ITATARTARIC ACID PRODUCTION BY GAMMA ISOLATES OF ASPERGILLUS TERREUS. Jakubowska, Jadwiga; Nowakowska-Waszczuk, Anna; Lasota-Dulkowska, Ewa; Zakowska, Zofia; Sobocka, Barbara (Technical Univ., Lodz, Poland). Acta Microbiol. Pol., 16: 227-36(1967).

Irradiation was employed in attempts to obtain biochemical mutants of A. terreus able to produce from glucose larger amounts of itatartaric acid and its lactone. Irradiated conidia were kept in the dark for 1.5 hr, then transferred into complete medium (malt-agar) and incubated at 30° for 48 to 72 hr. Single colonies characterized by high growth rate were isolated. A total of 37 strains producing itaconic acid were obtained among all 232 isolates derived from γ-irradiated conidia of A. terreus NRRL 1960, and 27 were able to produce larger amounts of itatartaric acid than the parent strain. In surface culture the highest contents of itatartaric acid (0.64 g per 100 ml) were obtained after 23 days of fermentation. The conversion of itatartaric acid to its lactone, β-hydroxyparaconic acid, was observed. In pure solution the equilibrium was attained after 17 days. In glucose media, after 11 to 23 days of fermentation, the proportion of β-hydroxyparaconic acid to itatartaric acid was 0.86. (BBB)

50450 THE EFFECT OF SULFAGUANIDINE AND p-NITROBENZOIC ACID ON THE LOSS OF GENETIC MATERIAL BY γ, X, AND β IRRADIATION IN VICIA FABA. Lazanyi, A. (Centre of Biological Research, Cluj). Rev. Roum. Biol., Ser. Bot., 13: 235-9(1968).

Main roots of Vicia faba were (β-, γ-, and x-irradiated in H_2O, and in sulfaguanidine (SG) or p-nitrobenzoic acid (PNBA) solutions. The irradiation-induced root growth inhibition was increased by these substances. The anaphase chromosome aberration scoring showed an enhancement of chromatid-reunions by irradiation in SG or PNBA, that caused the increase of the genetic material loss. In addition, by irradiations the SG and PNBA considerably promotes the interphase-death of cells. (auth)

Health Physics and Safety

Refer also to abstracts 49934, 50007, 50048, 50102, 50122, 50259, 50487, 50516, 51361, 52066, 52067, 52072, and 52074–52076.

50451 (CEA-CONF-1337) INFORMATION AND DATA USED IN EVENT OF AN ACCIDENT. Jammet, H. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). [nd]. 5p. (In French). (CONF-690509-5; SM-119/51). Dep. CFSTI (U. S. Sales Only).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria.

An inventory of essential data both in the physics and in the medical domains is presented. The physics information covers the nature, modality, and importance of the irradiation for accidental external irradiation and radioactive contamination. The medical information covers diagnostic, therapeutic, and prognostic data for accidental external irradiation and for accidental radioactive contamination. (J.F.P.)

50452 (PHS-999-RH-33) GUIDELINES TO RADIOLOGICAL HEALTH. Environmental Health Series. Radiological Health. Lectures Presented at the International Conference at McGill University, Montreal, Canada, August 17–21, 1967. (Bureau of Radiological Health, Rockville, Md.). 1968. 173p. (CONF-670848). Dept. of Health, Education, and Welfare, Rockville, Md. Free.

Under the sponsorship of the U. S. Department of Health Education, and Welfare, Public Health Service, National Center for Radiological Health, and the Department of National Health and Welfare, Radiation Protection Division, Ottawa, Canada, the International Conference on "Guidelines to Radiological Health" was held at McGill University, Montreal, Quebec, Canada, August 1967, to discuss radiological health problems, as presented by a group of experts. Speakers from the United States, Canada, Great Britain, and Japan presented papers on three major topics: Radiation Injury, Preventive Measures, and Sources of Radiation and Epidemiology, and included the fields of diagnostic and therapeutic radiation, industrial exposure to radiation, changes induced by irradiation of nutritional elements, and radioecological concentration processes. Separate abstracts were prepared for 24 of the papers for inclusion in NSA. (auth)

For abstracts of individual papers see: 49897, 50279, 50416, 50417, 50453, 50461, 50462, 50481, 50549–50551, 50569–50573, 50611, 50808, 50832, 50833, 50890–50892, and 50965.

50453 (PHS-999-RH-33, pp 116-21) EDUCATION AND TRAINING FOR A PEACEFUL NUCLEAR WORLD. Bruckner, Benjamin H. (National Center for Radiological Health, Rockville, Md.).

The education and training needed by persons who work in the radiological sciences are discussed; government support areas are listed. Typical training programs required in radiological sciences are outlined. It was concluded that the education and training goals for a peaceful nuclear world properly have a three-phased priority order: immediate, intermediate, and long-range; these are discussed. (C.O.)

50454 (NRL-6802) INTERACTION OF RADON DECAY PRODUCTS WITH AEROSOLS. Saunders, A. W. Jr.; Patterson, R. L. Jr.; Lockhart, L. B. Jr. (Naval Research Lab., Washington, D. C.). Dec. 31, 1968. 26p. CFSTI.

An instrumented plastic chamber with a 1.2-m^3 capacity was constructed and used to study the stability of some submicron dioctyl phthalate (D.O.P.) aerosols and their interaction with the short-lived radioactive decay products of radon (^{222}Rn). The degree of attachment of the radon decay products to the D.O.P. aerosols in this chamber was shown to be a function of the relative areas of the aerosol and wall surfaces. At high aerosol concentrations (10^5 particles/cm^3), 90% or more of the short-lived decay products were attached to aerosol particles. At lower aerosol concentrations and particularly when convection increased the availability of the walls for deposition, the airborne radioactivity was much less. Under the proper conditions appreciable quantities of unattached radon descendants will remain airborne. A few preliminary studies with these free atoms or simple molecules showed that they are effectively retained by fibrous filters. They thus provide a useful tool for evaluating the retentivity of filter media toward extremely small particles and for studying the mechanism of particle capture through diffusive processes. (auth)

50455 VOPROSY DOZIMETRII I ZASHCHITY OT IZLUCHENII. VYPUSK 8. (Problems of Dosimetry and Radioprotection. Number 8). Kimelya, L. R., (ed.). Moscow, Atomizdat, 1968. 224p.

Thirty-five articles are included on: protection against cosmic radiation; accelerators; accumulation of γ radiation of various energies and source geometries; γ radiation penetration through non-homogeneous materials; and γ radiation from fallout and other sources of contamination. Total proton doses from solar flares during prolonged spaceflight, protective devices against particulate radiations, and accelerator shield scattering and computation of radiation protection in accelerators are discussed in the first four articles. High-energy neutron distribution in shielding, concentration of low-energy γ quanta, and γ ray penetration through various media are estimated in the next eight articles. The composition of fission products and their content in the atmosphere and in the USSR specifically are covered in the next ten articles. The remainder of the articles discuss the dosimetry of β particles in terms of detector sensitivity and quality of background. Methods for improving the stability of industrial generators are also discussed. (R.V.J.)

Radioactive Contamination and Decontamination

Refer also to abstracts 50066, 50097, 50300, 50328, 50395, 50396, 50401, and 50587.

50456 (BNWL-1051(Pt.2), pp 73-5) ^{55}Fe LEVELS IN HUMANS LIVING IN RICHLAND, WASHINGTON, 1968. Jenkins, C. E.; Langford, J. C. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Iron-55 concentrations in Richland, Washington, residents are presently decreasing 3 to 4 nCi per year and are 1.4 times the levels observed in 1968 cattle. Maximum ^{55}Fe concentrations oc-

curred four years later than the atmospheric fallout peak concentrations. (auth)

50457 (CEA-CONF-1382) HELOPHYTE PLANTS: DETECTORS OF RADIOACTIVE POLLUTION. Chamel, A.; Fourcy, A.; Pautou, G. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). [1969]. 14p. (In French). (CONF-690918-1). Dep. CFSTI (U. S. Sales Only).

From Conference on Radioecology, Cadarache, France.

Helophytes (biological type reed) are represented by several species of different ecology but show a rather good concentration factor and, thereby, are able to take a prominent place as bioindicator for radioactive contamination of continental waters. The concentration factor was evaluated by experimental contamination (Phragmites) and by radioactivation of stable elements (Baldingera and Arundo). This last genus allows an enlargement of results to the Mediterranean region. (auth)

50458 (CONF-671135-, pp 169) THE RISE AND FALL OF IMPORTANT FISSION PRODUCTS IN THE UNITED STATES FOOD SUPPLY. Tompkins, Paul C. (Federal Radiation Council, Washington, D. C.).

The rise and fall of the content of ^{137}Cs, ^{131}I, ^{89}Sr, and ^{90}Sr in the United States food supply is briefly discussed. It was stated that the rise and fall of these fission products in food is a direct function of the radioactive half-life of the isotope and the fallout rate when the food and/or animal feed is growing. It was noted that the ^{137}Cs content of milk was decreasing faster than the ^{90}Sr content; this was attributed to greater availability of ^{90}Sr to plants once it contaminates the soil. (C.O.)

50459 (HASL-204) FALLOUT PROGRAM. Quarterly Summary Report, September 1-December 1, 1968. Hardy, Edward P. Jr.; Rivera, Joseph (New York Operations Office (AEC), N. Y. Health and Safety Lab.). Jan. 1, 1969. 318p. Dep. CFSTI.

Interpretive reports and notes covering ^{238}Pu and ^{90}Sr in the stratosphere, ^{90}Sr in surface air and a comparison between continental and oceanic concentrations, analytical quality control, γ radioactivity profiles over Northern Chile, nuclear debris from Southern Hemisphere tests over the central U.S., ^{137}Cs in air, food, and humans in the Chicago area, and a review of ^{210}Pb metabolism are presented. Tabulations of radionuclide levels in stratospheric air, surface air, fallout, milk, other diet components, and tap water are included. A bibliography of recent publications related to radionuclide studies is also presented. (auth)

50460 (ORNL-TM-2721) FOURTH QUARTERLY PROGRESS REPORT ON THE THEORETICAL EVALUATION OF CONSUMER PRODUCTS FROM PROJECT GASBUGGY. Jacobs, D. G.; Kelly, M. J. (Oak Ridge National Lab., Tenn.). Oct. 1969. Contract W-7405-eng-26. 13p. Dep. CFSTI.

Liquids from the Gasbuggy well were assayed for tritium. The production of tritium in the form of drip liquids at the wellhead would represent somewhat less than 3% of the total daily tritium production. During processing of gas there are releases that occur due to in-plant utilization. The impact of these releases for the hypothetical processing of 1 M^3 cf per day at the Blanco plant was assessed. (auth)

50461 (PHS-999-RH-33, pp 33-44) METABOLISM OF RADIONUCLIDES IN WORKERS. Butler, Gordon C. (National Research Council of Canada, Ottawa (Ontario). Div. of Radiation Biology).

The metabolic behavior of inhaled radioisotopes is discussed in relation to the effects of the chemical form on the retention or excretion. The use of mathematical equations, compartmental analysis, and bioanalysis to evaluate these factors was considered. A system of equations for describing retention and to assist in calculating radiation doses to specific areas resulting from chronic uptake are discussed. Radioisotopes considered included ^{137}Cs and ^{90}Sr. Plutonium and UO_2 were also discussed. It was concluded that most intakes of radioactive materials encountered in practice would give trivial doses of radiation to the body or critical organ. (C.O.)

50462 (PHS-999-RH-33, pp 124-7) NATURAL RADIATION. Hill, Christopher R. (Institute of Cancer Research, Sutton (England). Surrey Branch).

Man's normal natural radiation environment is summarized in tabular form. The data are discussed with regard to measurement techniques (cosmic-ray heavy particle component and short-lived α emitters), radiobiological interpretation (choice of RBE value and inhomogeneities in distribution), and variations between different population groups. (C.O.)

50463 GAMMA SPECTROMETRY OF MARINE ALGAE FROM THE WEST COAST OF INDIA. Unni, C. K.; Viswanathan, R. (Bhabha Atomic Research Centre, Bombay). Health Phys., 15: 543-5(Dec. 1968).

As part of a radioecological survey of the West Coast of India a study was made of the γ spectra of a few dominant species of marine algae. Specimens of Padina, Sargassum, Ulva and Spyridia were collected from areas with radiation background varying from 0.02 mrad/hr (Control Areas in Bombay, Ratnagiri and Veraval) to 1 mrad/hr (Monazite Areas in Kovalam and Manavalakurichi). Dry algal ash was examined using a well-type 3 in. × 3 in. NaI(Tl) crystal integral line assembly and 512-channel pulse height analyzer attached to an oscilloscope and computer readout typewriter. Monazite sand (8.88% ThO_2, 0.35% U) was used for the identification of the photopeaks of the thorium series. (INIS) (UK)

50464 STUDIES ON RADIOACTIVE CONTAMINATION OF FOOD IN BELGIUM DURING THE YEARS 1965 AND 1966. Cantillon, G. E. Arch. Belg. Med. Soc., Hyg., Med. Trav. Med. Leg., 26: 22-41(Jan. 1968). (In French).

Data are presented on the content of ^{137}Cs and ^{90}Sr in various foods sampled in Belgium during 1965 and 1966. The data were used to calculate the uptake of these radioisotopes by human adults and adolescents based on the consumption of an average diet. (C.H.)

50465 CONTENT OF ^{137}Cs IN MUSCLES OF RABBITS AND HARES. Hay, Jan; Szulc, Marcin; Jaworek, Dariusz (Higher School of Lower Economics, Warsaw). Med. Wet. (Poland), 24: 321-3(June 1968). (In Polish).

Examinations of 51 specimens of hare and rabbit muscle during the winter of 1965 and 1966 revealed that the average ^{137}Cs activity in picocuries is much higher in rabbits (1372) than hares (239); while in cattle it is 516. Possible differences in cesium metabolism in rabbits are discussed. (J.P.R.S.)

50466 ON THE PREVENTION OF HAZARDS AND INJURIES RESULTING FROM THE RELEASE INTO THE SEA-WATERS OF RADIOACTIVE LIQUID WASTES FROM FUEL-REPROCESSING FACILITIES, ETC. Kagaku Gijutsucho Geppo, No. 152, 9-10(Apr. 1969). (In Japanese).

In March 1968, the Deliberative Council for Radiations was requested by the Prime Minister to report on the prevention of hazards and injuries resulting from the release in the sea-waters of radioactive liquid wastes from fuel-reprocessing facilities, etc. After repeated deliberations in a sub-committee, the conclusions thereof were obtained in February 1969 and subsequently reported to the Prime Minister. The report in its entirety is given. Data are included on the total exposure doses, internal and external exposure doses, populations concerned, and atomic facilities involved. The results of deliberations, including characteristics of the radiation exposures caused by the release in the sea-waters, permissible levels of exposure doses, control of the sea-water environment, release of radioactive liquid wastes, releases from many atomic facilities, and monitoring and estimate of radioactivities in the sea-waters are discussed. (NSA of Japan)

50467 SOILS AND AGRICULTURE OF EASTERN PANAMA AND NORTHWESTERN COLOMBIA. Gamble, J. T.; Chu, R. Ah.; Fiskell, J. G. S. (Univ. of Florida, Gainesville). Bioscience, 19: 529-30, 535(June 1969).

The interaction of fallout radionuclides with soils used agriculturally in Panama and Columbia, as pertains to nuclear excavation of a sea level canal, is considered. Previous agriculture food chain relation studies were concerned primarily with ^{90}Sr, ^{137}Cs, and ^{131}I. Other radioisotopes that require evaluation are those of Ce, P, Mn, Fe, and W, and tritium. It was necessary to determine stable isotope levels for all of the essential elements in the food plants and soils of the area, and, in addition, W, Cs, Sr, and Ce. Because of the importance of coconuts and bananas (plantains) and the lack of radioisotope uptake data, they were selected as the crops to be used in obtaining some first approximations of uptake, translocation, and concentration of critical radioisotopes. A special study of the beef industry was also made because of its potential in the economy of the area and, as an export commodity, potential radionuclide concentrations deserve special consideration. In environmental-radiation hazards analysis, the soil factor becomes more important with time. After the initial nuclear excavation, the direct contamination from fallout will cease and the soil will be the source of radionuclides. To assess the potential hazard from soil, a soil survey was made and principal soil types selected for detailed study. Soil samples were collected with all crop samples to correlate possible crop compositional variations with soil extract analysis. To further assess the potential of soils for nuclide retention, a radiotracer experiment was conducted. Six nuclides were compared in pairs ($^{59}Fe-^{54}Mn$; $^{86}Rb-^{137}Cs$; $^{45}Ca-^{89}Sr$). A table presents elemental analyses determined on soil extracts obtained by using neutral ammonium acetate as the extracting agent. (BBB)

50468 MEASUREMENT OF ^{137}Cs IN MEAT FROM DIFFERENT SPECIES, 1965–1967. Underdal, Bjarne (Veterinary Coll. of Norway, Oslo). Nord. Veterinarmed., 20: 344–53(1968).

Twenty references are presented dealing with the properties of ^{137}Cs and its behavior through the food chains. Meat from different species was sampled at 14 slaughterhouses from 1965 to 1967. In addition to this, samples of lynx and glutton (wolverine) were analyzed. The ^{137}Cs concentration is found to increase in order: swine–cattle–horse–sheep/goat–reindeer–glutton–lynx. A considerable variation from district to district was found. A decrease in the ^{137}Cs concentration in the order of 30 to 60% was found during the investigation period. (auth)

50469 PROCESS FOR THE DESTRUCTION OF CELLULOSE-CONTAINING MATERIAL CONTAMINATED WITH RADIOACTIVE MATERIAL. (to Atomenergikommissionen). French Patent 1,410,017. Filed Sept. 24, 1964.

A process for destruction of cellulose-containing material contaminated with radioactive material comprises suspending the material in cold concentrated H_2SO_4 and conducting the suspension down below the surface of concentrated H_2SO_4 maintained at a temperature in the range 300 to 330°C to which is added a catalyst, e.g., Se for oxidizing the cellulose-containing material to CO_2 and H_2O. (NPO)

50470 PROCESS FOR DECONTAMINATING IRRADIATED CELLULOSE-CONTAINING TEXTILES. (to Heberlein and Co. AG). French Patent 1,423,525. Filed Feb. 5, 1965.

A process for decontamination of irradiated cellulose-containing textiles comprises treating the textiles in a NaOH or KOH solution having a concentration that exceeds the mercerizing concentration, e.g., 4 to 9 N for natural and 2.5 to 5 N for regenerated cellulose, at a temperature in the range 10 to 100°C for a time in the range 5 to 20 min. (NPO)

50471 RESEARCHES ON RADIOCONTAMINATION IN HOKKAIDO. PART 8. THE UP-TO-DATE LEVELS OF RADIOCONTAMINATION. Ando, Yoshiaki; Sato, Yoko (Hokkaido Inst. of Public Health, Sapporo). Hokkaidoritsu Eisei Kenkyushoho, No. 19, 242-7(June 1969). (In Japanese).

In order to know the background levels of environmental radiocontamination in Hokkaido, data on surveys for radioactivity in rainwater, drinking water, milk, soil, etc., which had been measured since 1963, were assembled and described in this paper. These data are summarized as follows: The strontium-90 content of monthly deposits of rainwater showed a rapid drop at the end of 1964 and thereafter decreased gradually to a level as low as natural background. The annual changes in the values of Sapporo showed a similar trend to those of the mean values of all Japan throughout the whole period. The annual levels of strontium-90 contents in drinking water of Wakkanai were about three times those of Sapporo, the latter being close to the average levels of all Japan. The concentrations of strontium-90 and cesium-137 in milk of Sapporo showed a considerable high level compared with the average one of all Japan during the period from 1964 to 1966, but soon decreased to the same level. The strontium-90 and cesium-137 contents of soil in Sapporo were nearly equal to the mean values of all Japan. The levels of the gamma radiation dose rate on the surface of ground were slightly higher in summer than in winter. (NSA of Japan)

50472 RETENTION OF RADIOSTRONTIUM, STRONTIUM, CALCIUM, AND PHOSPHORUS BY INFANTS. Kahn, B.; Straub, C. P.; Robbins, P. J.; Wellman, H. N.; Seltzer, R. A.; Telles, N. C. (Public Health Service, Cincinnati). Pediatrics, 43: 651-756(Apr. 1969).

A study of ^{90}Sr intake, excretion, and retention by children in their homes was begun in 1960 to obtain metabolic information for predicting internal exposure from the ingestion of ^{90}Sr deposited in world-wide fallout. Balances were measured in consecutive 28-day periods. The diets were selected by the parents on the advice of their pediatricians, and consisted of milk, commercially available premodified milk formulas, and packaged infant foods. Calcium, P, and ^{90}Sr balances were available for 30 infants in a total of 214 periods. The corrected average daily intake was 0.50 g Ca and 0.46 g P. The respective corrected average daily fecal excretions of Ca and P were 0.29 and 0.16 g and urinary excretions were 0.031 and 0.18 g. The average daily Sr intake by 25 infants observed was 0.60 mg, at a Sr/Ca ratio of 1.24 m/g. The amount of Sr and the Sr/Ca ratio in the diet varied widely, which suggests that extensive sampling is needed to obtain representative values for a large population. Milk and formula supplied most of the dietary Sr. Strontium intake and fecal excretion increased gradually with age, but urinary excretion and retention remained constant. A simple compartment Sr model was constructed by combining inform tion from the Ca and Sr balances. The daily ^{90}Sr intake by the infants from foods contaminated with environmental fallout was between 2 and 17 pCi. Strontium-90/Ca ratios were grouped at 3 to 15 and 23 to 29 pCi/g, depending on the intensity of fallout during the 4-yr study period. Strontium-90 from milk and premodified milk formulas constituted 79% of the total, and the average $^{90}Sr/Ca$ ratio in the total diet relative to that in milk and formulas alone was 1.10. Of the ingested ^{90}Sr, about 76% was excreted in feces and 9% in urine, and 15% was retained. Strontium-90 values, specific activities, and $^{90}Sr/Ca$ ratios in excretion and retention, although not directly proportional to intake, were linearly related to it. The increase in the $^{90}Sr/Ca$ ratio in the infants from 1.7 pCi/g at birth to 5.0 pCi/g at age 300 days was similar to changes measured in bone between 1960 and 1964. (BBB)

50473 DECONTAMINATION OF HUMAN SKIN FOLLOWING RADIATION INCIDENTS. Koerner, H. J. Zentralbl. Arbeitsmed. Arbeitsschutz, 17: 146-7(May 1967). (In German).

Methods for removal of radioisotopes from skin are briefly discussed. Emphasized is the efficiency of removing the superficial cell layers of the skin by means of a polyurethane sponge. (H.B.G.)

50474 VARIATION OF STRONTIUM–CALCIUM OBSERVED RATIO (URINE/DIET) IN MAN. Fujita, M.; Iwamoto, J.; Kondo, M. (Japan Atomic Energy Research Inst., Tokai). Health Phys., 16: 441-7(Apr. 1969).

The amounts of fallout ^{90}Sr and stable Ca in the diets and urine of several volunteers were determined for about 90 days and the strontium–calcium Observed Ratio (urine/diet) was calculated from the data. The OR values obtained are interpreted as a function of the ratio of urinary Ca to dietary Ca. The OR values obtained for the Japanese volunteers (0.2 to 0.4) were less than one half of American and European values (0.75 to 1.0). It is suggested that the level of dietary Ca plays an important role in determining the OR values. (auth) (UK)

50475 WHOLE-BODY RETENTION OF ^{85}Sr IN SWINE GIVEN SODIUM ALGINATE OR BARIUM AND SODIUM SULFATES. Milin, L.; Anderson, J. J. B. (Univ. of Illinois, Urbana). J. Nutr., 97: 181-4(Feb. 1969).

Dry sodium alginate was given orally to immature and mature swine 10 min following oral administration of ^{85}Sr. The whole-body retention of radiostrontium was higher in treated pigs, but was not statistically different from that of control animals. The ineffectiveness of sodium alginate may be attributable to a tough coating of alginic acid that is reported to form around dry sodium alginate in dilute acid, presumably making the alginate unavailable for metal binding. A barium sulfate and sodium sulfate mixture, given orally to pigs 10 min following oral administration of ^{85}Sr, significantly decreased whole-body retention of radiostrontium in young swine; on day one only in older pigs. Whole-body ^{85}Sr retention in young pigs given the sulfate mixture was significantly less than that of control swine through day 10 following oral radioactivity dosing. Differences in the whole-body retention of ^{85}Sr on day 3 and day 10 following oral administration of the radionuclide were not significant in treated and control mature swine, indicating that treatment need not be repeated in mature swine, but might be warranted in young animals. (auth)

Dosimetry and Monitoring

Refer also to abstracts 50105–50107, 50130, 50138–50140, 50142, 50157, 50174, 50182, 50191, 50456, 50552, 50698, 50720, 50764, 50782, 50787, 50801, 50910, 50916, 51040, 52068, and 52381.

50476 (BNL–13998) COMPARISON OF DISTANCE- AND ENERGY-RESTRICTED LINEAR ENERGY TRANSFER FOR HEAVY PARTICLES WITH 0.25 TO 1000 MeV/amu. Baum, J. W. (Brookhaven National Lab., Upton, N. Y.). [1969]. 15p. (CONF-691012–1). Dep. CFSTI.

From 2nd Symposium on Microdosimetry, Ispra, Italy.

While linear energy transfer (LET) has been a very useful concept in radiobiology, its limitations have often been noted. Frequently, correlation with radiobiological data has been improved by considering total LET in terms of a track-core fraction and a delta-ray fraction. The trackcore fraction can be estimated either for restricted delta-ray energy (L_Δ) or for restricted track radius (L_r). L_Δ is somewhat easier to calculate but L_r relates better to energy locally deposited. A new and simple method for calculating L_r is presented. Classical collision theory is used to predict energy, angle and number of secondary electrons. Cole's recent range-energy data are employed to determine energy deposition by electrons as they leave the track core. Results are compared for the two concepts (L_Δ and L_r). Largest differences are found for low energy particles and small track radii. Differences vary from fac-

tors of 1.5 to 5, depending on the assumptions one makes about the energy (average energy of ionization and excitation, I) contained in the atoms which experience the primary interactions. It is suggested that L_r is generally a better parameter than L_Δ for use in radiation damage studies such as those of interest in radiobiology. (auth)

50477 (CEA-CONF-1336) CONTRIBUTION TO THE PHYSICAL AND BIOLOGICAL DOSIMETRY IN CASE OF ACCIDENTAL OVEREXPOSURE. Jammet, H. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). [nd]. 19p. (In French). (CONF-690509-4; SM-119/52). Dep. CFSTI (U. S. Sales Only).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria.

Physics and biological dosimetric methods usable in the case of accidental overexposure are explained. Physics dosimetry covers measurements including collective and personnel dosimetry, and reconstruction of the accident; and dose evaluation including the total doses absorbed, and the absorbed local and integral doses. Biological dosimetry covers total evaluation including clinical evolution, the neurological and hematological syndromes, biochemical and chromosomic alterations; and partial evaluation including cutaneous, ocular, and gonadal radio-lesions. (J.F.P.)

50478 (CEX-65.11) ENERGY AND ANGULAR DISTRIBUTION OF NEUTRONS AND GAMMA RAYS: OPERATION HENRE. Thorngate, J. H.; Johnson, D. R.; Perdue, P. T. (Oak Ridge National Lab., Tenn.). Apr. 1969. 75p. Dep. CFSTI.

The HENRE experiment, conducted at the Nevada Test Site in the winter and summer of 1967, was an extension of the experimental programs related to the Ichiban program to determine the doses received by the survivors at Hiroshima and Nagasaki. The data obtained on the neutron and gamma-ray dose as a function of polar angle, the fast neutron spectrum as a function of distance, and the high energy gamma-ray spectrum as a function of polar angle are presented. It was found that the neutron spectrum did not reach equilibrium within the distances at which measurements were made. This has an effect on the dose as a function of polar angle measured with different air densities. In addition, the measurements show the gamma-ray dose received from angles below the air-ground interface is affected by the diffuse source of gamma rays. Where possible, these data have been compared with data from previous field experiments. In every case, they were compared with calculations which approximated the experiment. Agreement in both cases is generally good, and this strenghens confidence in calculated results. (auth)

50479 (NP-18031) POPULATION DOSE FROM X-RAYS, U.S. 1964. ESTIMATES OF GONAD AND GENETICALLY SIGNIFICANT DOSE FROM THE PUBLIC HEALTH SERVICE X-RAY EXPOSURE STUDY. Public Health Service Publication No. 2001. (Bureau of Radiological Health [Rockville, Md.]). Oct. 1969. 155p. GPO $1.25.

Estimates of gonad and genetically significant doses from diagnostic medical x-rays for the population of the United States are presented. Descriptions of the laboratory-based dosimetry, and of the methods of calculation are presented. The report includes 22 tables, and represents the first publication in an official source of such data for the United States. (auth)

50480 (ORNL-tr-2231) MATHEMATICAL MODEL FOR GASTROINTESTINAL TRACT DOSIMETRY: APPLICATION TO ADULTS. Vacca, Georges; Bazin, Jean-Pierre; Karhausen, Lucien (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Translated for Oak Ridge National Lab., Tenn., from report CEA-R-3707. 56p. Dep. CFSTI.

A new method is proposed for the computation of the dose delivered to any level of the gastrointestinal tract after ingestion of radioactive substances. The same method is used as that proposed by ICRP. The concentration of the radionuclide during the progression of the meal is the central concept of this model. A graph relates the MPC with the radioactive half-life of the radionuclide and with any level of the gastrointestinal tract of adults. (auth)

50481 (PHS-999-RH-33, pp 128-38) DOSIMETRY IN RELATION TO EPIDEMIOLOGY. Marinelli, L. D. (Argonne National Lab., Ill.).

The necessity of sharpening skills in radiation dosimetry of internal emitters is demonstrated. Comments on the assessment of the relevant external dose in epidemiology that presents a spectrum of difficulties and uncertainties are then made. It is concluded that if budgetary restriction is imposed, long-term effects studies should not be discontinued. (C.O.)

50482 (SLAC-Trans-100) UNDESIRABLE SECONDARY RADIATION IN THE IRRADIATION SPACE OF A SIEMENS 42-MeV BETATRON. Rassow, J.; Strueter, H.-D.; Lacin, E. Translated by L. B. Kapp for Stanford Linear Accelerator Center, Calif., from Strahlentherapie, 136: 183-95(1968). 26p. Dep. CFSTI.

The radiation transmitted by the casing as affected by the construction at all exterior surfaces adjoining the instrument head was measured on the 42 MeV Siemens betatron. The highest dose rate for all irradiation parameters was only 5% of the beam, and 0.4% at the level of the patient. The total secondary radiation from the phantom is an order of magnitude higher than the transmitted radiation at a distance of 50 cm from the irradiated field. The part of the hard component (HVL about 17 mm Pb) amounts to 15 to 60% of the secondary radiation at distances of 25, 50, and 100 cm from the central axis, but 100% of the transmitted radiation. The ambient doses in the treatment room were studied (for vertical and horizontal beams) with and without a phantom. All measurements were made with electrons and photons of 43 MeV peak energy. To allow calculations of the protective walls, the dose rates at a distance of 50 cm inside the walls are given for the largest field as a function of the thickness of the phantom and for the different beam compensators. (auth)

50483 (UCRL-50007-69-1, pp 6-13) OVERBURDEN ATTENUATION MEASUREMENTS FOR ^{239}Pu-^{241}Am USING THE FIDLER DETECTOR. Tinney, J. F.; Hoeger, T. O. (California Univ., Livermore. Lawrence Radiation Lab.).

X-ray to gamma-ray ratios are presented for plutonium-239 and americium-241 as a function of overburden thickness, overburden composition, and area of contamination. (auth)

50484 ROHRAD-AREA CURVES IN TREATMENT PLANNING. Carlson, James C. (Hackley Hospital, Muskegon, Mich.). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 106: 854-62(Aug. 1969).

In external ^{60}Co γ beam radiation therapy procedures, the determination of central axis tumor doses or isodose curves in rads requires several calculations on numbers secured from depth dose tables or graphs. These repetitious calculations can be eliminated by incorporating them into graphic or tabular presentation of depth dose data. Further simplification occurs by using an air exposure of 100 R to a 10 × 10 cm field as a reference point. The number obtained subsequent to these calculations has been given the name ROHRAD. ROHRAD-area curves (or tables) greatly simplify the calculation of central axis tumor doses in rads, reduce the occurrence of calculation errors, and simplify calibration chart construction for ^{60}Co γ units. (auth)

50485 CENTRAL-AXIS DEPTH-DOSE DATA FOR PHANTOMS OF 0- TO 25-cm THICKNESS IN ROENTGEN, ^{137}Cs, AND ^{60}Co THERAPY. Legare, Jean-Marc (Ministere de la Sante, Quebec). Radiology, 92: 1321-34(May 1969).

By means of two correction factors determined experimentally and standard semi-infinite phantom values, central axis depth-dose data were computed for phantoms with thicknesses of 0 (or near 0), 5, 10, 15, 20, and 25 cm. The resulting tables are given at every centimeter depth for x-ray machines with cones and ^{137}Cs and ^{60}Co units, operating with 4 × 4- to 20 × 20-cm fields at a 50-cm TSD or SSD. The tables are compared to the semi-infinite phantom values. (auth)

50486 CONTRIBUTION OF ANTHROPOGAMMAMETER TO THE PROBLEMS OF TOXICOLOGY AND HYGIENE. Delwaide, P.; Heusghem, C. (Univ., Liege). Ann. Biol. Clin. (Paris), 26: 725-40(May-June 1968). (In French).

Anthropogammametry, or whole-body counting, using external spectrometric measurement of gamma activity contained in the whole animal gives a particularly accurate and rapid method for studies of the principal problems of the toxicology of radioisotopes detection and qualitative determination, qualitative measurements, metabolism, and eventually localization. The principle of the method and the various types of practical applications of whole-body counters are reviewed. Examples of the important application of this technique to questions of nuclear hygiene include: old contaminations by radium; measurement of the effect of radioactive fallout; and protection of personnel handling radioisotopes. In addition the whole-body counter, thanks to radioactive tracers, can be a promising approach to certain problems of the toxicology of heavy metals. (auth)

50487 OCCUPATION EXPOSURE OF ANESTHETISTS TO HALOTHANE, NITROUS OXIDE, AND RADIATION. Linde, Harry W.; Bruce, David L. (Northwestern Univ., Chicago). Anesthesiology, 30: 363-8(Apr. 1969).

To assess the exposure of operating room personnel to anesthetic vapors, measurements were made of the concentrations of nitrous oxide or halothane in the air of operating rooms while the anesthetics were being administered. Exposure of 10 anesthetists

to radiation in the operating room over a 6-week period was also measured. The average concentration of halothane was 10 and that of nitrous oxide 130 ppM. Halothane was also found in the air expired by anesthetists, and fluorine-containing substances were found in their urine. Exposure to radiation was measured by an electrostatically charged chamber dosimeter worn in the operating room. If the individual wore a lead apron during x-ray exposure, the dosimeter was worn outside the apron. Although the average exposure to radiation over the period of study was well below the currently acceptable limit of 100 mR/week (5 R/yr), two values in the first week (95 and 70 mR) approached this limit. After the first week, the individual and average values tended to decrease sharply and to level out. (This phenomenon is well known to health physicists; a dosimeter makes the wearer conscious of radiation and more cautious, thus his exposure soon drops.) It appears possible, however, that anesthetists could easily be exposed to excessive irradiation, and the effects of radiation and anesthesia could be additive. (BBB)

50488 DETERMINATION OF BODY BURDEN IN DIAGNOSTIC ROENTGENOLOGY. Gursky, S. (Karl Marx Univ., Leipzig). Roentgenpraxis, 22: 67-73(Mar. 1969). (In German).

By means of phantom measurements, an attempt was made to assess the dose to body parts, especially gonads, outside the direct radiation field. It is emphasized that errors and limitations of the method should be taken into consideration in patient dosimetry. (H.B.G.)

50489 DOSIMETRY FOR BETATRONS. Markus, Benno (Univ., Goettingen, Ger.). Roentgenpraxis, 22: 53-67(Mar. 1969). (In German).

Theoretical and practical aspects of dosimetry in living tissues are discussed for protons and electrons exceeding one MeV. Advantages and problems are surveyed for ionization chambers, chemical dosimeters, thermoluminescence dosimeters, solid state dosimeters, and calorimeters. (H.B.G.)

50490 METHODS FOR AUTOMATIC REPRESENTATION OF CALCULATED DOSE DISTRIBUTION. Schoknecht, G. (Staedtische Auguste-Viktoria-Krankenhauses, Berlin). Roentgenpraxis, 22: 73-80(Mar. 1969). (In German).

With a digital computer, calculation of cobalt-60 dose distribution in the human body leads to a dose matrix. From this matrix, isodose curves can be obtained by linear interpolation. Principles of computer programs for isodose diagrams are discussed for printouts, graph plotters, and analog visual presentation. (H.B.G.)

50491 HIGH-ENERGY RADIATION THERAPY DOSIMETRY. Conference Held at New York, June 15, 16, and 17, 1967. Krauss, Marc (ed.). Ann. N. Y. Acad. Sci., 161: 1-370(July 3, 1969). (CONF-670665).

Separate abstracts were prepared for 41 of the 42 papers (excluding introductory and concluding remarks) in this conference. The other paper describes an experimental situation for which data are not yet available. (E.R.B.)

For abstracts of individual papers see: 50179–50181, 50183–50186, 50492–50512, 50760–50766, 50809–50811, 50844, 50944, and 52059.

50492 INTERPRETATION OF BIOLOGICAL RESPONSE IN TERMS OF MICRODOSIMETRY. Rossi, Harald H. (Columbia Univ., New York). Contract AT(30-1)-2740. Ann. N. Y. Acad. Sci., 161: 260-71(July 3, 1969).

From Conference on High Energy Radiation Therapy Dosimetry, New York. See CONF-670665.

A method was developed for the measurement of event size distributions involving the use of proportional counters having tissue-equivalent walls and filled with tissue-equivalent gas. Even when successful measurements were made down to sizes of $1/_{10}$ of a micron or less, there were certain complications due to backscattering of σ rays by the wall. It is therefore necessary to develop a wall-less proportional counter. In addition, the strong indication that one must, at least in some cases, be dealing with associated sites suggests the need for experimentation in more complicated shapes, with particular emphasis on coincidences in multiple volumes. The definition and determination of radiation quality must also be taken into account in interpreting biological response. (E.R.B.)

50493 AN EMPIRICAL EXTENSION OF THE FORMULA FOR SCATTER OF CASSEN AND COLLEAGUES AND ITS RELATION TO OTHER QUANTITIES ASSOCIATED WITH RADIATION THERAPY DOSIMETRY. Glover, J. R. (Univ. of Rochester, N. Y.). Ann. N. Y. Acad. Sci., 161: 348-53(July 3, 1969).

From Conference on High Energy Radiation Therapy Dosimetry, New York. See CONF-670665.

The scatter-predicting equation of Cassen and his colleagues is shown to be empirically verifiable and is shown to be a first approximation to an equation for scatter derived here. The presently derived system of equations is continuous in depth and area and can be used in a scheme based on the Clarkson method for the calculation of off-axis depth dose. (auth)

50494 EXPERIENCE IN RADIOBIOLOGICAL DOSIMETRY WITH HIGH-DOSE-RATE ELECTRONS. Griem, M. L.; Skaggs, L. S.; Lanzl, L. H.; Malkinson, F. D. (Univ. of Chicago). Ann. N. Y. Acad. Sci., 161: 317-22(July 3, 1969).

From Conference on High Energy Radiation Therapy Dosimetry, New York. See CONF-670665.

Two methods of biological evaluation of high-dose-rate electrons were presented using mammalian cells in tissue culture and using isotope incorporation in proliferating hair. The lack of skin reaction observed with high-energy electrons was studied by these two methods. (auth)

50495 DOSIMETRY AND BIOLOGICAL PARAMETERS IN STUDIES OF THE RELATIVE BIOLOGICAL EFFECTIVENESS OF HIGH-ENERGY ELECTRON BEAMS. Kim, J. H.; Pinkerton, A.; Laughlin, J. S. (Sloan-Kettering Inst. for Cancer Research, New York). Ann. N. Y. Acad. Sci., 161: 310-16(July 3, 1969).

From Conference on High Energy Radiation Therapy Dosimetry, New York. See CONF-670665.

HeLa S-3 cells in culture were used to determine the RBE of a 20-MeV electron beam at the 100 and 25% relative depth dose of a polystyrene phantom. It was found that the survival curves at the two different depths were similar and the extent of the recovery from the sublethal irradiation was not significantly different. The clonal size distribution revealed no qualitative differences between the two depths. It was thus concluded that the RBE of 20-MeV electrons at the two depths was not significantly different, and the published variability in the RBE with depths might have resulted from the variation in the depth-dose curves, the geometrical and environmental conditions, and the postirradiation incubation. (auth)

50496 PROBLEMS OF HIGH-ENERGY ELECTRON DOSIMETRY IN RADIOBIOLOGICAL EXPERIMENTS. Markus, B. (Univ., Goettingen, Ger.). Ann. N. Y. Acad. Sci., 161: 282-300 (July 3, 1969).

From Conference on High Energy Radiation Therapy Dosimetry, New York. See CONF-670665.

With high-energy electrons, as with other ionizing radiation, the absorbed dose within the irradiated biological object is in general not immediately obtainable by measurements. All special tasks of electron dosimetry are divided into two groups: The geometrical dimensions of the object are large compared to beam diameter and maximum range within the object, and the chemical composition and density of the object are homogeneous; the geometrical dimensions of the object are comparable to or smaller than the beam diameter and/or its maximum range within the object, and/or the object is not homogeneous in chemical composition and/or density, i.e., the object has outside or inner border surfaces. It was demonstrated that in the latter the spatial dose distribution within the object is inhomogeneous by different absorption and scattering of the electrons. Typical examples were given. The dose estimation can be very difficult if the critical volume is situated near border surfaces and requires special precautions. Some of them are described. They have to be done in such a manner that no physiological disturbances result. Restrictions concerning the kind of objects are the consequence. Properties of the ideal object are summarized and examples of good approximations given. The task of dosimetry is then reduced to the first group. The requirements of a suitable measuring device for this case are compiled. The significance of a LET-independent dosimetry in radiobiology and radiotherapy is emphasized, and allowance is made for the degraded energy spectrum within the irradiated object. Examples for the influence of the latter in radiobiological experiments are dealt with. In this connection, dose measurements with a thin extrapolation ionization chamber are compared with those of LiF dosimetry in the same phantom. The adequacy of both methods in determining the absorbed dose in different body depths is demonstrated to be of such an accuracy that the influence of the degraded electron spectrum in radiobiological reactions may appear significantly. A comparison of corresponding measurements with a regular phantom chamber is made. (auth)

50497 THE IAEA PROGRAM IN MEDICAL RADIATION DOSIMETRY. Loevinger, R.; Pfalzner, P. M.; Eisenlohr, H.; Malo, S. A.; Sanielevici, A.; Nagl, J. (International Atomic Energy Agency, Vienna). Ann. N. Y. Acad. Sci., 161: 158-67 (July 3, 1969).

From Conference on High Energy Radiation Therapy Dosimetry, New York. See CONF-670665.

50498 POLICY OF THE NATIONAL RESEARCH COUNCIL OF CANADA ON HIGH-ENERGY CALIBRATION. Henry, W. H. (National Research Council of Canada, Ottawa). Ann. N. Y. Acad. Sci., 161: 154-7(July 3, 1969).

From Conference on High Energy Radiation Therapy Dosimetry, New York. See CONF-670665.

50499 APPROACH OF THE NATIONAL PHYSICAL LABORATORY TO SERVICE CALIBRATION OF ABSORBED DOSE. Jennings, W. Alan (National Physical Lab., Teddington, Eng.). Ann. N. Y. Acad. Sci., 161: 146-53(July 3, 1969).

From Conference on High Energy Radiation Therapy Dosimetry, New York. See CONF-670665.

50500 CALCULATION OF ENERGY AND CHARGE DEPOSITION AND OF THE ELECTRON FLUX IN A WATER MEDIUM BOMBARDED WITH 20-MeV ELECTRONS. Berger, M. J.; Seltzer, S. M. (National Bureau of Standards, Washington, D. C.). Contract R-80. Ann. N. Y. Acad. Sci., 161: 8-23(July 3, 1969).

From Conference on High Energy Radiation Therapy Dosimetry, New York. See CONF-670665.

Preliminary results are presented from an investigation on the penetration of high-energy electrons (mainly 20-MeV beams) into a water phantom, with particular reference to energy and charge deposition; electron flux (differential in energy), including primary and secondary electrons down to a spectral energy of 400 eV; and distribution of delta-ray track ends. All of these quantities have been obtained as a function of the depth for a broad incident beam. Some results for energy dissipation have also been obtained for a narrow beam, as functions of depth as well as radial distance from the beam axis. (auth)

50501 THE EFFECT OF INHOMOGENEITIES ON DOSE DISTRIBUTIONS OF HIGH-ENERGY ELECTRONS. Brenner, M.; Karjalainen, P.; Rytilae, A.; Jungar, H. (Univ. Central Hospital, Helsinki). Ann. N. Y. Acad. Sci., 161: 233-42(July 3, 1969).

From Conference on High Energy Radiation Therapy Dosimetry, New York. See CONF-670665.

It was demonstrated that the perturbation of the electron isodose distribution by high-density domains of bone-equivalent material and cavities of limited lateral dimensions is due mainly to scattering. From this it follows that the dose at inhomogeneities of this type cannot be evaluated from depth-dose curves through infinitely wide layers along rays emanating from the source. The underdose behind bone and the overdose behind cavities are more pronounced with narrow than with very broad domains. The results show 20% underdose and 15–35% overdose, respectively, with the bone pieces and the cavities studied by us. With thicker domains, even larger effects are expected. Although only some special cases were studied, they illustrate the phenomena involved. One may by simple assumptions be able to generalize the results for the evaluation of distributions at domains of arbitrary thickness and density. The shape independence indicates that the integrated effect may be proportional to the volume. This is reasonable if we assume that the electrons mainly are scattered by a sizable angle only once within the domain. (auth)

50502 HIGH-ENERGY ELECTRON DOSE PERTURBATIONS IN REGIONS OF TISSUE HETEROGENEITY. Boone, Max L. M.; Almond, Peter R.; Wright, Ann E. (Univ. of Texas, Houston). Ann. N. Y. Acad. Sci., 161: 214-32(July 3, 1969).

From Conference on High Energy Radiation Therapy Dosimetry, New York. See CONF-670665.

The dose perturbations in living tissues have been investigated using lithium fluoride thermoluminescent dosimeters and parallel studies were carried out in physical phantoms. From these studies, methods were derived for correcting the standard dose distributions so that inhomogeneities may be taken into account during treatment planning. (B.G.D.)

50503 CALCULATED AND MEASURED DOSE DISTRIBUTIONS IN INHOMOGENEOUS MATERIALS AND IN PATIENTS. Pohlit, W. (Max Planck Institut fuer Biophysik, Frankfurt am Main). Ann. N. Y. Acad. Sci., 161: 189-97(July 3, 1969).

From Conference on High Energy Radiation Therapy Dosimetry, New York. See CONF-670665.

Classification of different types of inhomogeneities which may be encountered in electron therapy is attempted. Approximate, easy methods for dose calculation in these cases are proposed. (B.G.D.)

50504 DISCUSSION [ELECTRON BEAM ENERGY CALIBRATION]. Ovadia, Jacques (Michael Reese Hospital and Medical Center, Chicago). Ann. N. Y. Acad. Sci., 161: 181-6(July 3, 1969).

From Conference on High Energy Radiation Therapy Dosimetry, New York. See CONF-670665.

The need for calibration of electron beams at energies of 20 to 40 MeV has led to an investigation of threshold reactions in this range. Several of these reactions are evaluated. (B.G.D.)

50505 AAPM/HPA SURVEY OF HIGH-ENERGY ELECTRON DEPTH-DOSE DATA. Schulz, R. J. (Albert Einstein Coll. of Medicine, New York). Ann. N. Y. Acad. Sci., 161: 176-80(July 3, 1969).

From Conference on High Energy Radiation Therapy Dosimetry, New York. See CONF-670665.

A survey of high-energy electron depth-dose data obtained from twelve installations is presented. The significant variations in the data are discussed. It is concluded that the depth-dose data should be expressed in terms of half-value depth (HVD). (B.G.D.)

50506 THE HPA AND AAPM SURVEY OF DEPTH-DOSE DATA FOR TELE-ISOTOPE γ RAYS AND MEGAVOLTAGE X-RAYS. Greene, D. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Ann. N. Y. Acad. Sci., 161: 168-75 (July 3, 1969).

From Conference on High Energy Radiation Therapy Dosimetry, New York. See CONF-670665.

Some typical comparisons between depth dose data published in supplement 10 of the British Journal of Radiology and subsequent measurements are presented. The examples arise from depth-dose measurements of cesium-137 γ rays, cobalt-60 γ-rays and 2–35 MV x-rays. (B.G.D.)

50507 PROPOSED NATIONAL BUREAU OF STANDARDS PROGRAM FOR THE CALIBRATION OF INSTRUMENTS USED IN HIGH-ENERGY ELECTRON AND X-RAY BEAMS. Ehrlich, Margarete (National Bureau of Standards, Washington, D. C.). Ann. N. Y. Acad. Sci., 161: 139-45(July 3, 1969).

From Conference on High Energy Radiation Therapy Dosimetry, New York. See CONF-670665.

The National Bureau of Standards (NBS) recently started a program that is to lead to the establishment of an absorbed-dose calibration service for high-energy x-rays and electrons. Two phases of the program are discussed: (1) the uniformity check of the calibrations performed by the users of high-energy electron beams and (2) the long-range research and development plans connected with the future absorbed-dose instrument-calibration service for high-energy x-rays and electrons. (auth)

50508 INTERCOMPARISON AND CALIBRATION OF HIGH-ENERGY X-RAYS AND ELECTRONS. Holt, J. G. (Memorial Hospital for Cancer and Allied Diseases, New York); Almond, P. R.; Meurk, M. L. Ann. N. Y. Acad. Sci., 161: 133-8(July 3, 1969).

From Conference on High Energy Radiation Therapy Dosimetry, New York. See CONF-670665.

The results of intercomparisons of absorbed dose measurements carried out between specific institutions are presented, as well as a description of the procedures employed. (B.G.D.)

50509 DISCUSSION [DOSIMETRY AND RADIOTHERAPY]. Worsnop, Ralph (Univ. of California, San Francisco). Ann. N. Y. Acad. Sci., 161: 187-8(July 3, 1969).

From Conference on High Energy Radiation Therapy Dosimetry, New York. See CONF-670665.

The relationship between radiation dose measured in tissues and dose stated by radiotherapists is investigated by analysis of results from clinical trials. (B.G.D.)

50510 BIOPHYSICS OF RADIATION ABSORPTION. Roesch, W. C. (Battelle-Northwest, Richland, Wash.). Contract AT(45-1)-1830. Ann. N. Y. Acad. Sci., 161: 27-9(July 3, 1969).

From Conference on High Energy Radiation Therapy Dosimetry, New York. See CONF-670665.

A statistical analysis of the connection between radiation absorption and biological events is presented. (B.G.D.)

50511 RELATION BETWEEN ABSORBED DOSE AND CAVITY IONIZATION FOR HIGH-ENERGY ELECTRON BEAMS IN WATER. Kessaris, Nikitas D. (Sloan-Kettering Inst. for Cancer Research, New York). Ann. N. Y. Acad. Sci., 161: 24-6(July 3, 1969).

From Conference on High Energy Radiation Therapy Dosimetry, New York. See CONF-670665.

The ratio of absorbed doses to cavity ionization determined from theoretical and experimental investigations is examined for high-energy (~10 MeV) electrons in water. (B.G.D.)

50512 DISCUSSION [ELECTRON DOSIMETRY IN INHOMOGENEOUS MATTER]. Skaggs, L. S. (Univ. of Chicago). Ann. N. Y. Acad. Sci., 161: 257-9(July 3, 1969).

From Conference on High Energy Radiation Therapy Dosimetry, New York. See CONF-670665.

The interaction of electrons with inhomogeneous matter is examined. A portion of the electron depth-dose curve resulting from a combination of the effects of knock-on secondaries, scattering, and bremsstrahlung losses is analyzed. (B.G.D.)

50513 GENETIC X-RAY DOSE SET AT 55 MILLIRADS YEARLY IN U. S. Your Radiol., 10: No. 2, 7-9(Spring 1967).

A survey is reported that estimated the diagnostic radiology gonad dose in the United States to be 55 mrad/yr, and means of reducing this dose are briefly outlined. This estimate is lower than most previous, less accurate estimates and is based upon the first nationwide study. U. S. residents now receive an average of twice as many x-ray examinations in a year as do residents of most European countries. The level of usage continues to rise, requiring continuing care to minimize radiation hazards. The survey indicated that medical diagnostic radiation accounts for only about half as much absorbed dose as the 120 mrad of natural background radiation received annually in most parts of the country. The 55 mrad included an estimate of 53 mrad from film procedures and only 2 mrad from fluoroscopic examinations. Half of all diagnostic x-ray studies are chest examinations but these contributed only 4 mrad of genetic exposure. Examinations of the colon accounted for 10 mrad, those of the lumbar or lower spine were rated at 10, intravenous pyelograms (kidney studies) came to 7, views of the pelvis resulted in 4, and studies of the upper-gastro-intestinal system produced only 3 mrad. All other examinations including the head, neck, arms, and legs accounted for 17 mrad of the annual total of 55. Exposure to men accounted for 44, exposures to women 10, and those to unborn children 1 mrad. Excessive x-ray beam size was encounted most frequently as a cause of increased exposure during diagnostic radiology. (BBB)

50514 EMISSION AND ABSORPTION OF X RAYS. Anneroth, Goeran (Karolinska Institutet, Stockholm). Odontol. Revy, 19: 383-400(1968).

Fundamental and practical aspects of the generation of x rays and their absorption by tissues are reviewed. Methods for microradiography of oral tissues are discussed. The influence of the energetic processes secondary to the photoelectric absorption on contact microradiographic studies of biological tissues is explained. With certain restrictions in wavelength of radiation and composition of the absorbing tissues, the mass absorption coefficient is governed by the photoelectric absorption and the scattering process. The different energetic processes which govern the absorption of x radiation are illustrated. The energy liberated in these processes can affect the photographic emulsion so that the real absorption of x radiation in a biological sample can be underestimated even if the corresponding energetic effect in the reference system balances to a certain extent that from the tissue. Photoelectric absorption is a function of the wavelength of the x-ray quantum incident on the absorber and of the at. no. of the absorbing element, and is not governed by the molecular structure or physical status of the elements in the absorber. Scattering is very small in relation to photoelectric absorption. (BBB)

50515 ABSORBED RADIATION DOSE IN SOME SCINTIGRAPHIC STUDIES. Husak, V. (Radioizotopove Oddeleni Fakultni Nemocnice, Olomouc, Czech.). Cesk. Radiol., 22: 297-307(Sept. 1968). (In Czech).

Equations for calculating absorbed doses of radioisotopes administered in diagnostic procedures are derived and applied to studies employing ^{197}Hg, ^{203}Hg, ^{198}Au, ^{199}Au, ^{99}Mo, ^{99m}Tc, ^{51}Cr, ^{131}I, and ^{125}I. Appropriate physical data are tabulated for each of these isotopes, and methods in which they are used are described. Details for various techniques for calculating the absorbed dose from radioisotopes employed in the scintigraphic investigations are outlined, along with formulas, tables, and graphs for providing rapid information on the physical characteristics of isotopes and on the values of absorbed doses in the kidneys, liver, spleen, and thyroid gland. The total-body doses are also calculated. Emphasis is given to the correct calculation of absorbed doses for isotopes that, apart from β and γ radiation, also emit x rays, and conversion and Auger electrons. (BBB)

50516 RADIATION PROTECTION AND APPLICATION OF BETA RAYS. Schikarski, Wolfgang. Hautarzt, 18: 316-18(July 1967). (In German).

The production of bremsstrahlung by absorption of β radiation by the metals contained in shields of β-irradiation applicators was reviewed and compared. The γ dose rate was estimated to be from 0.7 to 0.8 mR/hr at a distance of 10 cm from the back of a 1 mCi $^{90}Sr-^{90}Y$ applicator, and from 0.008 to 0.009 mR/hr at 1 m distance. With a 1-mCi β applicator of the Al type A construction the lateral γ dose rates at 3.6, 30, and 50 cm distances were 7.6, from 0.12 to 0.216, and from 0.039 to 0.077 mR/hr, respectively. For 1-mCi β applicators with Ni type B construction, lateral dose rates at 3.6, 10, 20, 30, and 40 cm distance were 2.7, 3.6, 1.0, 0.44, and 0.11 mR/hr, respectively. However, since the time that the measurements were made, β applicators with improved shielding were developed. It was concluded that the γ radiation from β applicators of the $^{90}Sr-^{90}Y$ types studied should not be considered to present irradiation hazards. (BBB)

50517 BIOLOGICAL DOSIMETRY IN ATOMIC BOMB SURVIVORS. Sasaki, Masao S. (Tokyo Medical and Dental Univ.); Miyata, Hisatoshi. Nature (London), 220: 1189-93(Dec. 21, 1968).

It was found that the frequency of chromosome aberrations in circulating lymphocytes provided a good estimate for absorbed dose in survivors of an atomic bomb explosion. (auth) (UK)

50518 PERSONNEL MONITORING OF RADIOLOGISTS DURING FLUOROSCOPY. Bushong, Stewart C.; Harle, Thomas S.; Pogonowska, Magadalena; Burdine, John A. (Baylor Univ., Houston, Tex.). Radiol. Health Data Rep., 9: 627-30(Nov. 1968).

Measurements were made of the dose of x radiation received at various parts of the body by radiologists during fluoroscopy. On the basis of these data, radiologists and technologists should wear a film badge on their collars outside of the protective lead apron during fluoroscopic examinations. Radiologists should glove both hands, but for radiologists who will not glove both hands, the ungloved hand should be monitored. Finger rings would be more desirable, but they are less reliable. For those installations that have thermoluminescence capabilities, its use for hand and wrist monitoring is suggested. (C.H.)

50519 MEMORIAL IMPLANT DOSIMETRY APPLICATION SYSTEM. Balter, Stephen (Memorial Hospital for Cancer and Allied Diseases, New York). Radiology, 92: 161-2(Jan. 1969).

The MIDAS-1 is a version of the system for computerized radiation implant dosimetry developed at Memorial Hospital for Cancer and Allied Diseases, New York. The advantages of the system are discussed briefly. The system is applicable to the dosimetry of low-energy x or γ emitters. (C.H.)

50520 USE OF ACTIVITY INDUCED IN TISSUE TO DETERMINE DOSE FROM PARTICULATE RADIATIONS. Stickley, E. E.; Azzam, Nabil (Medical Coll. of Virginia, Richmond). Radiology, 92: 168(Jan. 1969).

Tissue radioactivity following exposure to energetic heavy particles has been used for dosimetry and localization studies in a variety of ways and situations. It has been noted in the literature that there are inherent difficulties which impede the application of this principle to determine dose and its uniformity among an irradiated animal population. The largest problems seem to be complexity of the resultant activities and geometrical variations during both exposure and counting procedures. These differences were accommodated in experiments in which mice were bombarded with protons at 300 and 600 MeV. Geometry of the target animals during irradiation was made uniform by confining them in plastic tubes so that they presented equal cross sections to the beam, taking the weight of each mouse to calculate its appropriate g/cm^2 value. Uniformity of dose with depth along the axis of the animal was checked in a separate experiment, using a stack of polystyrene foils of equivalent presented area. Whole-body counting of the animal was done in a two-crystal arrangement with dual shadow shields, minimizing the effects of movement and of nonuniform distribution of activity in the subject. Calibration employed both a standard positron source and the stack of polystyrene foils, each counted individually in a simple crystal counter, with the stack of foils (mouse phantom) also counted in the whole-body counter. Only carbon-11 activity was determined in this work; interference of other induced activities was eliminated by using a single-channel pulse-height analyzer and by waiting the appropriate time for other positron activities to decay. This procedure was used successfully to select uniform exposure sites in the proton beam as well as to set exposure times and to check the doses received. (auth)

50521 DETERMINATION OF THE RADIOACTIVE ISOTOPES INCORPORATED IN THE ORGANISM BY MEANS OF THE WHOLE-BODY COUNTER. Andrasi, Andor; Bozoky, Laszlo; Feher, Istvan. Fiz. Szemle, 18: 299-305(1968). (In Hungarian).

In order to be able to measure the natural radiation of the human body and that caused by small amounts of incorporated radioisotopes, the background radiation must be greatly reduced. Whole-body counters were developed for this purpose. The detector consists of a scintillator, usually a NaI(Tl) single crystal, and a photomultiplier. For shielding, a 15 to 20 cm thick iron wall, or its equivalent, is used. Determination of the dose rate requires a careful calibration of the system, either directly or by comparison with a standard. A whole-body counter was built at the National Oncological Institute in Hungary in 1962. The detector has a resolution of 12% for 662 keV. The signals are processed by a 512-channel amplitude analyzer. After in vivo calibration with ^{137}Cs

and ^{40}K, it was found possible to determine the natural K content of the human body with a precision of ±5%. The measurements were made within a counting period of 30 minutes, allowing measurements for isotopes emitting 1 to 2 nCi of γ radiation. Incorporated ^{192}Ir, ^{65}Zn, and ^{226}Ra could also be measured. From the data obtained, the biological half-life of ^{137}Cs was calculated to be about 64 days. (TTT)

50522 ROTATIONAL TECHNIQUE FOR ASSESSING QUANTITY AND DISTRIBUTION OF BODY RADIOACTIVITY. Anderson, J. L.; Olson, D. G. (to United States Atomic Energy Commission). U. S. Patent 3,431,413. Mar. 4, 1969.

This patent relates to a method of whole-body radioactivity scanning and counting that provides a helical scan pattern. This is accomplished by simultaneously providing relative longitudinal and rotational movement between a radiation detector and a subject and counting the signals emanating from the detector during the scan. (auth)

50523 INTRACAVITARY MEASUREMENTS OF ABSORBED DOSES. Petushkov, A. A.; Meshcheryakov, A. B.; Narkevich, B. Ya.; Konstantinov, I. E.; Korf, N. N.; Demisheva, N. K. (Inst. of Labor Hygiene and Occupational Diseases, Moscow, Inst. of Physics Engineering, Moscow). Med. Radiol., 14: No. 9, 52-5(Sept. 1969). (In Russian).

A technique is described for measuring absorbed doses of x and gamma-radiation with the aid of a needle-like silicon transistorized dosimeter both on phantoms and in vivo on biological objects. Calculations are given providing for the nonequivalence of the silicon detector and soft biological tissues. The characteristics of two such dosimeters and some results of measurements performed with their aid on laboratory mice irradiated with a beam of radiation from RUM-7 apparatus are presented. (C.O.)

50524 EFFECT OF SURFACE CONVEXITY OF TARGET FIELDS ON DOSAGE DISTRIBUTION IN IRRADIATION PLANS FOR TELECOBALT THERAPY. Chvojka, Zdenek; Reinisch, Erich; Huskova, Marie (Karlova Univ., Hradec Kralove, Czech.). Cesk. Radiol., 22: 188-92(May 1968). (In Czech).

The surface convexity of target field for telecobalt γ therapy may exert a significant effect on practical application only as regards percentage values of final tracings in isodose plans. The configuration of isodose tracings is altered so little in this respect that changes are negligible for practical purposes. This was shown on several isodose plans in which the effects may result in changes caused by surface irregularity. (auth)

50525 QUANTITATIVE DESCRIPTION OF IONIZING RADIATION AND IRRADIATION. Somerwil, A. (Rijks Instituut voor de Volksgezondheid, Utrecht). Ned. Tijdschr. Geneesk., 111: 2169-73(Dec. 2, 1967). (In Dutch).

Because of considerable confusion and misunderstanding in the medical world about the use of internationally recommended terms, quantities, and units, a description is given of the more common terms. These include directly ionizing particles, indirectly ionizing particles, ionizing radiation, and transferred energy. Verbal descriptions of the uses of dosimetry units point up misconceptions prevalent in some medical units about the meaning of the terms exposure, rad, rem, and roentgen. Dutch equivalents of absorbed dose, and exposure are defined, and the definitions of the Dutch Union for Radiology embellished. Similarly, the relative effective dose and the relative biological effect are defined. Statements of the ICRU on the use of the dose equivalent are elaborated; examples showing conversions of units are worked out. (BBB)

50526 EVALUATION OF DOSE EQUIVALENT FROM NEUTRON ENERGY SPECTRA. Shaw, K. B.; Stevenson, G. R.; Thomas, R. H. (Rutherford High Energy Lab., Chilton, Eng.). Health Phys., 17: 459-69(Sept. 1969).

The practical assessment of the dose equivalent involves the construction of a dose equivalent-depth curve for bilateral neutron irradiation. This procedure was used to calculate dose equivalent for broad neutron spectra typical of those observed around high energy proton synchrotrons. Routine methods of dose equivalent estimation were compared with the computer assessment. (auth) (UK)

50527 GONADAL EXPOSURE FROM INTRAORAL X-RAY EXAMINATION. Niwa, Katsumi (Tokyo Dental Coll.). Shika Gakuho, 69: 494-512(Mar. 1969). (In Japanese).

The x radiation dose to the gonads during dental radiography was measured using a Mix-D phantom. The effective energy of the primary x-rays generated by a dental x-ray machine operated at 64 kVp with total filtration of 1.5 mm Al equivalent is 27 keV. The effective energies of the secondary x-rays penetrating the different depths (3.5 cm, 7.5 cm, and 12.5 cm) of Mix-D, soft tissue and water exposed to an x-ray of 27 keV were 30 to 35 keV. Actual doses of gonadal exposure of male patients examined in a 10-film examination made with 64 kVp, were 0.13 to 0.25 mR with a long cone and 0.06 to 0.07 mR with a short cone. A leaded rubber apron reduced the doses by $1/10$ to $1/20$ with a long cone and by $1/5$ with a short cone. Draping a leaded rubber apron over the breast and pelvic region of the patient is a useful way to reduce the amount of radiation reaching the patient during dental radiographic survey. (NSA of Japan)

50528 CALCULATION OF NEUTRON FLUENCE-TO-KERMA FACTORS FOR THE HUMAN BODY. Ritts, J. J.; Solomito, M.; Stevens, P. N. (Oak Ridge National Lab., Tenn.). Nucl. Appl. Technol., 7: 89-99(July 1969).

Fluence-to-kerma factors (where fluence is the time-integrated neutron flux and kerma is equal to the total kinetic energy released in materials resulting from direct neutron interaction per unit mass of the irradiated medium) were calculated at discrete neutron energies from 0.025 eV to 15 MeV for various compositions in the human body—tissue, muscle, bone, lung, brain, red marrow, and the standard man composition. The 11 most common elements in man were considered and the latest cross sections used. An attempt was made to include all significant reactions, namely elastic scattering with an anisotropic correction, inelastic scattering, neutron capture (n,2n) reactions, (n,charged particle) reactions, and beta or positron emissions from these reactions. These calculations show improvements in the entire energy range over previously reported neutron kerma factors. (auth)

50529 DOSIMETRY IN INTRATISSULAR ADMINISTRATION OF ^{198}Au IN GRANULES WITH PLATINUM COVERING. Yakhontov, N. E.; Kopytkin, Yu. V. (Gorky Medical Inst., USSR). Med. Radiol., 14: No. 9, 55-8(Sept. 1969). (In Russian).

Tables are proposed that enable rapid and accurate determination of the absorbed dose in a given volume of implantation. The quantity of ^{198}Au granules, their activity, and the distance between them were selected in such a way as to create optimal conditions for the regular distribution of the dose in the irradiated tissues. (auth)

50530 PROTON MICRODOSIMETRY. Hilbert, Jerald W.; Baily, Norman A. (Emory Univ., Atlanta). Radiology, 92: 168-9(Jan. 1969).

An important assumption in using proportional counters for determination of frequency distributions of energy deposited in microscopic tissue volumes is that the ionizing particle flux entering the measuring volume is identical to that which would enter a tissue microvolume placed at that point in space. In the case of charged particles it is often impossible to satisfy this requirement using conventional methods, since different areas of the counter present different effective wall thicknesses to the incident particles, resulting in a significant perturbation of the primary protons' energy at low energies (<100 MeV) and of the secondary charged particles that comprise an important part of the tissue dose at high energies. An experimental technic was devised that permits determination of the frequency distributions of energy deposition along individual path lengths and yields the distributions in arbitrarily shaped microvolumes by the proper convolution of the individual partial responses. The experimental technic involves a small area detector in coincidence with a tissue-like gas-filled proportional counter, that may be used whenever the primary charged particles undergo minimal scattering in tissue. The method was illustrated for a tissue sphere of 1.77 micron diameter, irradiated with 40.0 MeV protons. Energy-deposition distributions for various gas paths were determined. Convolution of these spectra yields the distribution for the entire spherical microvolume. The energy-deposition distribution for the average path length in the sphere and the distribution that would result if there were no statistical fluctuations of energy loss in individual path lengths were also measured. (auth)

50531 MEASUREMENTS OF IONIZING RADIATION IN SOME HOUSES IN POLAND. Pensko, Jerzy; Mamont, Kalina; Wardoaszko, Tadeusz (Central Lab. for Radiation Protection, Warsaw). Nukleonika, 14: 415-24(1969). (In Polish).

A portable background gamma-radiation dosimeter with a high-pressure ionization chamber was designed. The gamma background radiation dose rate and radon concentration in the air of the 97 new flats were measured. The flats were selected in the houses of the experimental settlement in Stużewiec (quarter of Warsaw), of three settlements of Łódź, and of five settlements of the Upper Silesian Industrial Area. For the construction of these settlements building materials typical for new construction in Poland were used, such as products derived from metallurgical wastes like slag or boiler ash. The estimated dose rates were similar in the houses to those outdoors, but the radon concentration inside the buildings was several times higher. (auth)

50532 RADIATION DOSAGE IN LAMINAGRAPHY. Colton, Raymond H.; Hollien, Harry (Univ. of Florida, Gainesville). Med. Res. Eng., 8: 6(Mar.-Apr. 1969).

Radiation doses received by subjects undergoing x ray stroboscopic laminagraphy for studying laryngeal phenomena are reported. Radiation levels for stroboscopic laminagraphy are much less than those for ordinary image intensification. For example, at 70 kVp and 4.5 mA-sec, the radiation level for image intensification is 2.5 R/min. In these studies, such fluoroscopy is used to position the subject and locate the laminagraph plane. This procedure is limited to about 1 min per subject. Thus, most of the radiation time to subjects results from the stroboscopic laminagraphic mode. In this case, (at 70 kVp and 1 mA-sec) the radiation level is 0.75 R for 4 min. Accordingly, each subject is limited to a maximum total radiation time of 5 min, a period which consists ordinarily of 1 min of fluoroscopy (2.5 R) and 4 min of laminagraphy (0.75 R) for a mean total radiation dose of about 3.25 R. Naturally, increased use of image intensification or an increase in the frequency (x ray flashing rate) in the stroboscopic laminagraphy mode would increase the radiation level. On the other hand, the kVp and mA-sec values listed are maximums. Thus, it is safe to assume that most subjects receive only about 3 R for the entire project, and no subject is used more than once. (BBB)

50533 CALCULATION OF THE RADIATION HAZARD AT SUPERSONIC AIRCRAFT ALTITUDES PRODUCED BY AN ENERGETIC SOLAR FLARE. Armstrong, T. W. (Oak Ridge National Lab., Tenn.); Alsmiller, R. G. Jr.; Barish, J. Nucl. Sci. Eng., 37: 337-42(Sept. 1969).

Calculations were carried out to estimate the absorbed-dose and dose-equivalent rates at various depths in human tissues at various altitudes in the atmosphere exposed to the prompt proton spectrum of an energetic solar flare (the flare of February 23, 1956). Although there is some uncertainty associated with the flare spectrum and with the manner in which the dose rates were obtained from the calculated particle spectra, the calculations indicate that in the vicinity of polar latitudes and at the higher altitudes envisioned for supersonic aircraft flights, dose-equivalent rates as high as about 10 rem/hr are possible. (auth)

50534 EFFECTS OF CONTINUOUS EXPOSURE TO RADIOACTIVE PHOSPHORUS (^{32}P). DOSIMETRIC PROBLEMS AND ATTEMPTED EVALUATION OF THE DOSE-BIOLOGICAL EFFECT RELATIONSHIP IN CULTURES IN VITRO. Ferrero, B.; Orsello, S. (Univ., Turin). Cancro, 20: 602-17(1967). (In Italian).

Experiments on in vitro cell cultures with continuous and internal irradiation furnished by soluble ^{32}P present peculiar difficulties in the estimate of the absorbed dose and in the evaluation of the dose/effect relationship. Comparisons between the data obtained in different experiments are particularly hard. A conventional method is suggested for the evaluation of the dose/effect relationship. This method is derived from the classic R.B.E. (Relative Biological Efficiency) and it is based on dosimetric data obtained with the application of the dosimetric formula suggested by Loewinger for the internal irradiation of the pure β emittent radioisotopes. A numerical reactivity index (R) is obtainable for each culture with this conventional method. This index is proportional to the cellular radiosensitivity, and is based on the function of both threshold and lethal dose and, by rigorously standardized experimental conditions, it is directly comparable with the analogous index obtained from other tested cultures. (auth)

50535 CALCULATION OF dE/dx AND ENERGY LOSS DISTRIBUTIONS IN SPHERICAL CAVITIES FOR MONOENERGETIC NEUTRON FIELDS. Dvorak, Robert F. (Argonne National Lab., Ill.). Health Phys., 17: 279-93(Aug. 1969).

A computer program was prepared that calculates the average dE/dx and energy loss for events occurring in a spherical cavity due to incident monoenergetic neutrons. No assumptions are made as to distribution of path lengths. The particle paths are traced and a range-energy equation is used to calculate the cavity energy loss and average dE/dx for each event. The distribution in pulse height for events having the same average dE/dx is shown to be a function of both average dE/dx and the neutron energy, and to deviate from the commonly postulated triangular distribution at neutron energies below 1 MeV for a 2.08 μm cavity. Pulse height distributions and dose distributions in average dE/dx for several energies were computed. From the pulse height distributions LET distributions were calculated by a modified Rossi–Rosenzweig technique and compared with the computed average dE/dx distribution. The weighting factor relating energy loss and deposited dose equivalent for an event, as used with the survey instrument proposed by Baum (Health Phys., 13: 775(1967)), was also computed. It is shown to be dependent on the neutron energy, and to vary by as much as a factor of three in a region of heavy event population. (auth) (UK)

50536 DOSIMETRIC STUDY OF A COLLIMATED BEAM OF THERMAL NEUTRONS INTENDED TO BE USED IN VIVO ACTIVATION ANALYSIS. Sklavenitis, H.; Devillers, C.; Comar, D.; Kellershohn, C. (CEA, Orsay, France). Int. J. Appl. Radiat. Isotop., 20: 585-96(Aug. 1969). (In French).

In order to evaluate the absorbed dose in an individual locally irradiated by thermal neutrons with the intention of in vivo activation analysis, a study of the dosimetry of a collimated thermal neutron beam from the EL3 reactor at Saclay was undertaken. Thermal flux measurements were made at several depths in tissue-equivalent phantoms representing a human neck as well as a human leg. The absorbed dose due to the two main mechanisms of interaction of the thermal neutrons with the biological matter was evaluated theoretically as follows: (a) the absorbed dose due to the gamma rays from thermal neutron capture in hydrogen and every other element in tissue was computed by the Mercure 3, IBM-360 FORTRAN IV, program; (b) the absorbed dose due to the ^{14}N(n,p)^{14}C reaction was calculated by the use of the first collison dose per neutron per square centimeter formula. Direct measurements of the absorbed dose were also made with conventional ionization chambers. The absorbed dose due to the gamma rays coming directly from the reactor core, as well as to the fast neutron fraction of the beam, was evaluated experimentally by straight measurement with an ionization chamber of the dose rate behind a Li^{6}F shield. The dose equivalent thus evaluated at the surface of the phantom for a 3 cm diameter thermal neutron beam and flux of 1.25×10^{8} n cm^{-2} s^{-1} was made up as follows: (a) Gamma capture dose: 180 mrem/min; (b) ^{14}N(n,p)^{14}C reaction dose: 1190 mrem/min; and (c) direct gamma and fast neutron dose: 94 mrem/min. (auth) (UK)

50537 SIMPLE LIQUID SCINTILLATOR SOLUTION FOR ASSAY OF TRITIUM IN PLASMA OR SERUM. Evered, D. C. (General Infirmary, Leeds, Eng.). Int. J. Appl. Radiat. Isotop., 20: 608-11(Aug. 1969).

Most scintillators are non-polar organic compounds and, as such, impose limitations on the assay of tritium in biological fluids. The addition of hyamine hydroxide to the scintillator solution makes it possible to dissolve small volumes of plasma or serum, but has the disadvantage that some quenching occurs. The further addition of alcohols permits the solution of larger volumes of plasma and thus smaller quantities of hyamine hydroxide may be used. Alcohols produce considerably less quenching than hyamine hydroxide. A number of systems based on a xylene/hyamine/alcohol mixture were investigated in order to determine optimum conditions for assaying tritium in plasma or serum. (auth) (UK)

50538 ACCUMULATION OF FALLOUT ^{137}Cs IN NEWBORN INFANTS. Iinuma, T. A.; Ishihara, T.; Tashiro, S.; Nagai, T. (National Inst. Radiological Sciences, Chiba, Japan). Nature (London), 222: 478-80(May 3, 1969).

Some experimental work is described in support of the authors' calculations that the concentration of ^{137}Cs in infants, expressed as pCi/kg body weight, increases from birth to a maximum at about 50 days and then decreases slowly until 180 days. Infants were fed powdered milk of known ^{137}Cs fallout content (0.05 pCi/g) and were measured for body burden of ^{137}Cs using a plastic scintillator whole-body counter. It was found that the ^{137}Cs concentration in the infants was higher than that in their mothers during the period between 80 and 170 days. An explanation is given in terms of a metabolic model with reference to intake of powdered milk. The biological half-life of ^{137}Cs in the infants was also estimated, and it was found that the internal dose of ^{137}Cs can be critical in infants between birth and 180 days. The high concentration of ^{137}Cs in infants is due to the high ^{137}Cs content of milk together with the low body weight (the biological half-life in infants does not shorten in proportion to body weight). Some examples are given for Japanese children. (UK)

50539 CLINICAL AND DOSIMETRIC STUDY OF A CASE OF EXTERNAL IRRADIATION IN THE USE OF A ^{60}Co SOURCE. Strambi, E.; Tagliati, S. Med. Lavoro, 58: 573-87(1967). (In Italian). (RT/PROT-(68)14).

Methods are described that were used in the clinical study and the dosimetric evaluation of five cases involving personnel accidentally irradiated as a result of the malfunctioning of α and γ irradiation plant used for agrarian research. The estimated whole-body doses were respectively 12, 2.6, 2.5, 2.1, and 1.8 rem. In no cases did the clinical and laboratory findings show significant abnormalities. The possibilities and the limits of the so called biologic dosimetry in accidental irradiations are discussed with special regard to the value of binucleated lymphocytes and the study of chromosome aberrations in cultured leukocytes. (auth)

50540 THE RELATION OF RADIATION EXPOSURE TO THE EXPERIENCE OF THE EXAMINER AND THE CHARACTERISTICS

OF THE PATIENT. Schoen, Detlev (Univ., Tuebingen, Ger.). Strahlenschutz Forsch. Prax., 7: 31-48(1967). (In German).

Radiation exposures were reported to decrease for fluoroscopic studies of the thorax and stomach on the basis of data covering periods of up to 20 yr. Radiation burdens of patients decreased from a factor of 2.5 to 0.5 during this period. The radiation burden decreased from a factor of 1.5 to 0.5 as the experience of the fluoroscopists increased, up to 20 yr. The radiation burden tended to be lowest in patients who underwent gastric fluoroscopies early in the work week, and were highest in those fluoroscoped at the end of the work week. The patients with greatest body surface and weight received the greatest radiation burden. Body weight was more related to greater radiation burden in children and adolescents than in adults. Relative stature did not affect radiation burden, except for increases observed with fluoroscopy of the upper and lower extremities. Radiation burden increased relatively up to four times in age groups from 10 to 80 yr. Gastrointestinal fluoroscopy radiation burdens were relatively much larger than in thoracic or other types of fluoroscopy. For all organs studied the radiation burdens in patients with pathological findings were greater generally than in normal patients. (BBB)

50541 LOCALIZATION OF MOVABLE FOREIGN BODIES IN TISSUES BY MEANS OF TWO X-RAY TUBES AND AN IMAGE INTENSIFIER. Gramberg-Danielsen, B. (Verkehrsmedizinisch-Ophthalmologische Untersuchungsstelle des Allgemeinen Krankenhauses St. Georg, Hamburg). Chirurg, 40: 235-6(May 1969). (In German).

Radiation doses received from a combination of double x-ray beams and an image intensifier used for location of movable foreign bodies embedded in tissue varied with the transparency of the tissue to the x rays. At 90 kV and three mA the summed dose of the two irradiation fields was 10 R/hr, measured with a phantom in the axis of symmetry 20 mm above the patient. At two and four cm distance the dose rates were 6.7 and 1.8 R/hr, respectively. The doses were within the permissible range provided that localization and removal of the foreign body was accomplished within a few min and the operators avoided the main irradiation beam. It was necessary for the operator to wear a Pb apron, and the patient required shielding from secondary radiation. The irradiation dose received by the patient was low, even for a tissue as sensitive as the optic lens, but there was considerable irradiation of the gonads. (BBB)

50542 RADIATION PROTECTION VIEWPOINTS IN INDICATIONS FOR RADIOLOGIC DIAGNOSIS WITH INTERNAL AND EXTERNAL RADIATION SOURCES. Feine, U. (Univ., Tuebingen, Ger.). Strahlenschutz Forsch. Prax., 7: 13-9(1967). (In German).

Irradiation doses resulting from diagnostic procedures using x ray were compared with those from radioisotopes such as ^{99m}Tc, ^{131}I, ^{197}Hg, ^{203}Hg, and ^{198}Au used in nuclear medicine. Localized irradiation doses from angiography and pneumencephalography ranged from 10 to 50 rad and the gonad dose was less than 0.1 rad. In comparison, the whole-body dose from 10 mCi of ^{99m}Tc was 0.1 rad, and ranged from 0.08 to 0.5 rad for ^{131}I, ^{197}Hg, and ^{203}Hg when these radioisotopes were used in brain tumor scintigraphy. The thyroid irradiation dose was 1.5 rad/μCi and the gonadal dose was 0.08 rad/μCi of ^{131}I, as compared to thyroid doses of up to 0.5 rad and from 0.001 to 0.004 rad gonadal dose in x-ray studies of thoracic, esophageal, and tracheal areas. The whole-body and gonadal doses from bronchography and angiography both were from 0.1 to 1 and up to 0.002 rad, while with ^{131}I-albumin, the irradiation dose to lung and liver was 0.05 rad, and to gonads was from 0.002 to 0.003 rad. As compared to kidney irradiation dose from an intravenous angiogram of ~0.5 rad, kidney doses from ^{197}Hg or ^{203}Hg were four and 40 rad, respectively. The whole-body dose from a ^{131}I renogram was 0.002 rad, with a bladder dose of 0.004 rad. Lymph node studies with contrast media gave whole-body and gonadal doses of from one to two rad. With 100 μCi of ^{198}Au, the whole-body dose was 50 rad, and the gonadal dose was one to two rad. (BBB)

50543 EXPERIMENTAL DEMONSTRATION OF THE INFLUENCE OF BONE ON DOSE DISTRIBUTION IN RADIOTHERAPY. Debois, Jean M.; de Roo, Michel (Univ. Hospital St. Raphael, Leuven, Belgium). Radiology, 92: 1-10; 49(Jan. 1969).

Experimental measurements were made with an automatic isodose plotter to study the effect of bone on depth-dose data in a geometry simulating an anatomicoclinical situation. Different radiation energies (200 kVp, telecobalt and telecesium γ) were explored. The attenuation factors in the axis of the beam were determined, and the isodose curves were traced, adding a new dimension to the knowledge of the importance of the absorption in relation to the complete dose distribution. The measured absorption for all radiations studied was less than predicted by the classical theory expressed in textbooks. The results are tabulated and discussed. The principal point is that most bone structures consist of a predominance of spongy bone and, therefore, calculations based on compact bone density alone will yield correction factors that are too large. These results suggest that bone absorption must be taken into account in high-energy radiation treatment planning. (auth)

50544 MAXIMUM PERMISSIBLE CONCENTRATIONS FOR TRITIATED WATER AND TRITIATED THYMIDINE. Barber, Donald E. (Univ. of Minnesota, Minneapolis). Amer. Ind. Hyg. Ass. J., 30: 514-18(Sept.-Oct. 1969).

The electrons of importance biologically in the absorption of energy from β particles emitted by tritium have energies below 1 keV. These electrons have extremely short ranges that prompt the examination of absorbed energy on some basis other than average dose, such as ergs/gm. Tentative MPC's for tritiated water and tritiated thymidine are derived in this paper without reference to absorbed dose. The MPC's thus obtained are 10 to 100 times present recommended values. (auth)

50545 BRITISH APPROACH TO ENVIRONMENTAL MONITORING. Dunster, H. J. (United Kingdom Atomic Energy Authority, Windscale, Eng.); Kenny, A. W.; Neal, W. T. L.; Preston, A. Nucl. Safety, 10: 504-13(Nov.-Dec. 1969).

Environmental monitoring forms an integral part of arrangements in Britain for controlling radiation exposure of the public. When detectable exposure to radiation occurs, the critical pathway is used to establish the dose received by the critical population group. When no increase in exposure can be detected, the simplest possible indication systems are used to ensure that no significant change in the situation occurs. (auth)

50546 A SURVEY OF PROGRAMS FOR RADIOLOGICAL-DOSE COMPUTATION. van der Hoven, Isaac (Environmental Science Services Administration, Silver Spring, Md.); Gammill, William P. Nucl Safety, 10: 513-21(Nov.-Dec. 1969).

Most organizations now depend almost exclusively on computers for the assessment of the potential radiological doses that could result from reactor accidents postulated in safety-analysis reports. Computer programs are potentially capable of predicting doses with a higher degree of accuracy. (auth)

Radiation Protection

Refer also to abstracts 50199, 50225, 50727, 50750, 50772, 52065, 52069, 52070, and 52300.

50547 (NP-18025) ANNUAL REPORT FOR THE YEAR 1968. (National Radiation Lab., Christchurch (New Zealand)). 44p. (NRL-AR-19). Dep. CFSTI (U. S. Sales Only).

A brief history of the National Radiation Laboratory from the time of its establishment in 1933 by the New Zealand Branch of the British Empire Cancer Campaign Society is presented. The duties of the Laboratory are to administer radiation protection legislation, to provide licensees with any assistance that may require in the field of radiation physics, and to carry on research to ensure the accurate measurement and safe use of ionizing radiation for all purposes. Field services include regular visits to all places where radiation sources are used; emphasis is placed on reduction of patient exposure in the medical and dental use of x rays. When visiting radioisotope laboratories a detailed safety assessment is made which includes a scrutiny of the handling facilities, monitoring procedures, storage and waste disposal facilities, and measurement of surface activity and adequacy of records. Laboratory services are provided for monitoring of occupational radiation exposures, radiation measurements, technical services, administrative services, advisory services, education and training, and development of national radiation protection service in Thailand. Fallout monitoring was conducted for gamma radiation at six Pacific Island stations, for total beta activity in air and rainwater samples, and for measurement of specific radioisotopes as follows: ^{89}Sr and ^{90}Sr in rain, ^{137}Cs, ^{131}I, and ^{90}Sr in milk, ^{90}Sr in bone, and ^{131}I in cattle thyroid. Research and development work consisted of procedures for the determination of ^{90}Sr; soil studies; beta particle absorption studies; patient dosage in mass miniature chest radiography; radiation from television receivers; design of automatic sample changer; and contamination problems. (H.L.W.)

50548 (ORNL-tr-2185) STUDIES ON REMOVAL OF RADIOIODINE BY ACTIVATED CARBON. I. ADSORPTION OF IODINE AND METHYL IODIDE ON ACTIVATED CARBON. Murata, Toshifumi; Kamiya, Kunio. Translated for Oak Ridge National Lab., Tenn., from Nippon Genshiryoku Gakkaishi, 11: 138-43 (1969). 12p. Dep. CFSTI.

In order to obtain adsorption data for iodine and methyliodide at low partial pressures, helium gas containing iodine or methyliodide was passed through a small activated carbon bed, and the amount of iodine and methyliodide absorbed was measured. The specific adsorption of both iodine and methyliodide at temperatures from 50° to 400°C was determined, together with the rate of desorption and the amounts irreversibly adsorbed. From these results it was found that the rate of adsorption can be expressed by the equation given by Bangham, and the isotherms by that of Freundlich. The differential heats of adsorption were obtained through the use of Clausius-Clapeyron's equation. (auth)

50549 (PHS-999-RH-33, pp 62-71) PREVENTIVE MEASURES IN RADIOLOGICAL HEALTH. Terrill, James G. Jr. (National Center for Radiological Health, Rockville, Md.).

Preventive measures in radiological health, especially as related to the work of the National Center for Radiological Health of the Public Health Service, are discussed. Diagnostic x rays represented the largest single manmade source of radiation reaching the population in the United States. The story of x-ray emission from color television sets is reviewed. The value of data collection and assessment in establishing radiological health priorities is then discussed. Network and surveillance projects for monitoring radioisotope content of the environment are reviewed and the role of society in prevention of radiological health hazards is considered. (C.O.)

50550 (PHS-999-RH-33, pp 72-7) METHODS TO REDUCE RADIATION EXPOSURE IN DIAGNOSTIC RADIOLOGY. Moore, Raymond T.; Stewart, Harold F. (National Center for Radiological Health, Rockville, Md.).

Means for minimizing exposure from diagnostic medical radiology are discussed in relation to equipment design (x-ray equipment) and to operating techniques (proper and conscientious use by competent operators). Examples used in the review indicated past progress and future needs. (C.O.)

50551 (PHS-999-RH-33, pp 78-86) RADIOACTIVITY HAZARDS IN LABORATORY TECHNIQUES. McNeill, Kenneth G.; Harrison, Joan E. (Toronto Univ. (Ontario). Dept. of Physics).

Control of γ radiation doses to individuals from ordinary diagnostic tests using ^{131}I, ^{198}Au, and Thorotrast is discussed. The use of larger NaI crystals in whole-body counters to increase the efficiency of the detecting system, the use of high resolution detectors, the use of short-lived isotopes of iodine, oxygen, fluorine, and nitrogen, the use of in vivo activation analysis, and possible hazards of Thorotrast are included in the discussion. (C.O.)

50552 (RFP-1254) CONTROL OF PERSONNEL EXPOSURES TO EXTERNAL RADIATIONS IN A PLUTONIUM CHEMICAL PLANT. Owen, J. B. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). Sept. 3, 1969. Contract AT(29-1)-1106. 10p. Dep. CFSTI.

A practical approach to the control of personnel exposures to external radiations in a chemical plant handling kilogram quantities of plutonium in glove boxes is described. Calculated dose rates from various processing operations are compared to measured dose rates. Shielding materials for x rays, gamma rays, and fast neutrons and their economic and operational impact are discussed. Personnel training, rotation, and work habits which must be considered in maintaining exposures below the accepted guide levels are included. (auth)

50553 GENERAL PRINCIPLES OF PROTECTION AGAINST IONIZING RADIATIONS. Jammet, H.; Dousset, M. pp 211-47 of Genie Atomique. Tome II. Saclay, France, Institut National des Sciences et Techniques Nucleaires. Paris, Presses Universitaires de France, 1968. (In French).

The principal phenomena in the interaction between ionizing radiation and living tissue are reviewed and the basic concepts of energy transferred to tissue and dose equivalent are defined. In order to illustrate the significance of the basic safety norms, the pathological effects of radiations are reviewed. The applicability of safety norms and their numerical values are given. The application of basic norms is illustrated. The organization of a radiation protection service is outlined. (J.S.R.)

50554 SHIELD CONSTRUCTION FOR EXTENDED FIELD THERAPY OF HODGKIN'S DISEASE. Fordham, E. W.; Hibbs, G. G.; Hendrickson, F. R. (Presbyterian-St. Luke's Hospital, Chicago). Radiology, 92: 1374-6(May 1969).

A shielding method for extended field therapy of Hodgkin's disease is described. The method employs the use of styrofoam and relatively inexpensive tools. The advantages of this method for both the radiotherapist and the patient are discussed. (H.B.G.)

50555 RADIATION AT HOME. Roy. Soc. Health J., 89: 2-5(Jan.-Feb. 1969).

Radiation hazards encountered in the home and measures to prevent overexposure are reviewed. Recent studies have shown the problem of excessive radiation from color television receivers, have revealed leakage of potentially hazardous radiation from microwave ovens, and have shown the ready availability to the general public of lasers that, improperly controlled, can cause blindness. Color television receivers are now being designed to operate at around 30 KV and the discovery that they may emit x rays at dangerous intensities arose when one manufacturer recalled several thousand sets that were fitted with a new type of tube. This tube produced soft x-ray intensities up to 800 R/hr underneath the set. The circuit was redesigned and the tubes replaced. In the United Kingdom, manufacturers' specifications limit the x-ray intensity on the outside surface of the equipment housing to 0.5 mR/hr. This value is also recommended by the International Commission on Radiological Protection but is applicable at any readily accessible point 5 cm from the surface. Inspectors from the Department of Employment and Productivity (U.K.) visit the manufacturers of tubes and make radiation checks on typical samples. Microwave domestic ovens that cook a meal in seconds and automatic vending machines using microwaves to heat a pre-cooked meal are becoming common. Design specifications generally call for a maximum radiation intensity of 10 mW/cm^2 2 in. from a crack, but there are no nationally agreed standards of exposure. In addition, it is imperative that a perfect interlock system shall prevent microwaves from being generated when the oven door is opened. With many ovens it is easily possible to override the safety interlocks and thus cause exposure to hazardous levels. Some scientists favor reducing this value to 1 mW/cm^2 which is the maximum used by Russian designers. In the United Kingdom the domestic use of radiation-emitting equipment has not reached the extent that it has in the United States. However, with the increasing sales of color television receivers and with other developments such as microwave ovens, serious consideration needs to be given to protection of the householder from unnecessary exposure to harmful radiations. The result might be legal enforcement of a high standard of design, construction, and installation of radiation-emitting equipment. (BBB)

50556 RADIATION HAZARD, RADIATION PROTECTION. Bozoky, Laszlo (National Oncological Inst., Budapest). Fiz. Szemle, 18: 289-91(Oct. 1968). (In Hungarian).

The startup of the first reactor in 1942 represents the beginning of the second period in the development of radiation protection methods. The problems that arose during the first period related primarily to the medical applications of x radiation and to radium therapy. As the damaging effects were not immediately obvious, many physicians, nurses, and health technicians became victims. Recognition of the importance of the internal exposure represented an important step in the development of radiation protection; it became the duty of the International Commission for Radiological Protection to establish standards. After the discovery of nuclear fission, disposal of the accumulating fission products presented new problems; this resulted in the creation of a new discipline, health physics. The importance of this field is being recognized by a large number of international bodies, such as ILO, WHO, UNESCO, and ISO. Determination of the maximum permissible dose keeps receiving great attention. Scientific papers in this field are published, in English in "Health Physics" and in French in "Radioprotection"; the IAEA organized many symposia for discussing the important questions in this field. A specialized international society, IRPA was organized a few years ago. In Hungary, the Isotope Committee of the Academy of Sciences assumed responsibility for protection against radiation; more recently, this duty was assigned to the Ministry of Health. (TTT)

50557 RADIATION PROTECTION PROBLEMS ENCOUNTERED IN THE MEDICAL APPLICATION OF RADIOISOTOPES. Krasznai, Istvan (Medical Univ., Budapest). Fiz. Szemle, 18: 294-8(Oct. 1968). (In Hungarian).

Therapeutic applications of radioisotopes are carried out with sealed sources, operated at a distance or placed in direct contact with the patient, or by incorporating radioactive materials into the organism, where they may be accumulated in specific organs. In telegamma therapy, the operating personnel is protected by built-in shields and by special warning devices; the radiation burden of the patient is reduced by rotating the source. Patients treated with sealed sources applied to the body are kept in special rooms to protect the other patients and the medical personnel. Injection of radioactive liquids presents problems. In order to prevent contamination of the premises, all persons must wear protective clothing, shoe covers, gloves, etc. The increasing diagnostic use of radioisotopes aggravates the radiation burden of the population; this may be remedied by using more sensitive radiation detection instruments, allowing the detection of small amounts of radioactive materials. (TTT)

50558 DEVELOPMENT OF THE HAZARD IDEA IN THE INDUSTRIAL USE OF IONIZING RADIATIONS AND IN THE NUCLEAR INDUSTRY. Letard, H. (Electricite de France, Paris). Arch. Mal. Prof. Med. Trav. Secur. Sociale, 28: 183-5 (Jan.-Feb. 1967). (In French).

Criteria used in France for establishing the maximum permissible radiation dose for personnel in nuclear industries are summarized. Protection against the somatic effects of the cumulative radiation dose on individuals and the possible genetic effects on descendents were primary considerations. (C.H.)

50559 ON THE PRINCIPLE OF GENERAL AND THE WAYS OF SPECIAL CANCER PREVENTION. WITH SPECIAL REFERENCE TO IRRADIATION PROTECTION IN THE WATCH INDUSTRY. Zadik, P. Krebsarzt, 22: 251-61(1967). (In German).

Methods for protecting man from carcinogens found in the environment are discussed. It is pointed out that progress is being made in reduction of the exposure of human populations to automobile exhaust gases and tar derivatives of pyrobenzenes found in cigarette smoke and the contamination of the atmosphere by fallout radioisotopes has been reduced over previous levels. The excessive exposure of man to x radiation during diagnostic radiography has also been controlled. Radiation hazards from luminous paints used for watch dials are discussed. It is concluded that there is no radiation hazard from a single watch but there may be a hazard to personnel working where hundreds of these watches are produced and stored. Radiation protection legislation in Switzerland, where thousands of luminous dial watches are produced annually, is discussed. (C.H.)

50560 SOME DATA ON THE BIOLOGICAL ACTIVITY AND RADIATION PROTECTION OF OPTICAL QUANTUM GENERATORS. Gorodetskii, A. A.; Kirichinskii, B. R.; Evdokimov, I. R.; Kolesnik, V. M. (Inst. of Physiology, Kiev). Gig. Tr. Prof. Zabol., 12: 37-41(Jan. 1968). (In Russian).

Preliminary data are presented on some features specific to the biological action of the radiation emitted by optical quantum pulse-duty laser generators. Information characterizing the nature of radiations is cited and a number of general safety regulations in handling lasers are set forth. Emphasis is placed on the protection of eyes, both from direct and reflected radiation. (auth)

50561 BIOENVIRONMENTAL STUDIES OF THE RADIOLOGICAL-SAFETY FEASIBILITY OF NUCLEAR EXCAVATION. Martin, William E. (Battelle Memorial Inst., Columbus, Ohio). Bioscience, 19: 135-7(Feb. 1969).

Radiologic safety problems in the proposed nuclear excavation of a sea-level canal connecting the Atlantic and Pacific Oceans, are discussed. On-site survey studies have been made of topography, geology, hydrology, and hydrography to determine the engineering feasibility of the nuclear-excavation plan and the plan for conversion of the present canal to sea-level operation by conventional methods. The bioenvironmental studies required to evaluate the radiological safety feasibility of the nuclear excavation plan were made by subcontractor organizations under the management of Battelle Memorial Institute, Columbus Laboratories. The principal objective of the Bioenvironmental and Radiological Safety Feasibility Program is to estimate the potential external and internal radiation doses to human populations living in or near the areas most likely to be contaminated by radioactive fallout. These estimates will be compared with the standards and guidelines established for radiological protection by the ICRP (International Commission on Radiological Protection) and other such authorities, and recommendations will be made concerning actions that may be required to insure the radiological protection of project personnel and the general population. Other potential problems of a biological nature, e.g., the environmental disturbance to be expected in areas immediately adjacent to the canal route and the possible mixing of marine biotas previously separated by the isthmus, were considered to be of lesser importance in determining the feasibility of the nuclear-excavation plan because such problems could be anticipated even if the canal were to be constructed by conventional methods. Field studies in human, agricultural, forest, freshwater, and marine ecology and studies of hydrological and ecological transfer processes were undertaken to acquire the data and to develop the models needed to evaluate the major pathway terms for the potentially critical radionuclides. (BBB)

50562 MEASURES FOR REDUCTION OF IONIZING RADIATION DOSAGE TO NURSES IN GYNECOLOGICAL RADIUM APPLICATION. Rames, M. Cesk. Radiol., 22: 206-8(May 1968). (In Czech).

A device for fixation of the posterior vaginal speculum used at the oncological department of the regional hospital in Ústí nad Labem since 1961 is described. The device has been used in 1050 patients for gynecological applications of radium. Its use has reduced the exposure of the assisting nurse taking part in the operation to a minimum. Protective supports placed at a distance of 30 cm from the edge of the bed reduce to almost one half the intensity value of ionizing radiation to which the nursing staff is exposed during the course of radium therapy. (auth)

50563 RADIATION PROTECTION OF SHIGELLA FLEXNERI Y6R BY ETHANOL, β-MERCAPTOETHANOL AND SEVERAL POLYHYDRIC ALCOHOLS. Cramp, W. A. (Hammersmith Hospital, London). Int. J. Radiat. Biol., 15: 227-32(1969).

Ethanol, β-mercaptoethanol, and several polyhydric alcohols were shown to protect Shigella flexneri Y6R against the effects of ionizing radiation. At optimal concentrations ethanol was the least effective and β-mercaptoethanol the most effective; the polyhydric alcohols with 2, 3, and 4 hydroxyl groups per molecule all showed the same degree of protection. There was some qualitative correlation between effectiveness and the reactivities of these compounds with the hydroxyl radical. (auth)

50564 OCCUPATIONAL MEDICAL EXAMINATIONS AND IONIZING RADIATIONS. Manquene, J. (CEA, Paris). Arch. Mal. Prof. Med. Trav. Secur. Sociale, 28: 186-9(Jan.-Feb. 1967). (In French).

Radiation protection programs for personnel in radiochemical processing plants and other nuclear industries in France are discussed, with emphasis on the value of periodic medical examinations. In addition to maintaining a record of the physical condition of employees for use by employers for legal purposes, the periodic medical examination improves the emotional stability of personnel. (C.H.)

50565 RADIATSIONNAYA BEZOPASNOST' YADERNYKH KRITICHESKIKH SBOROK. (Radiative Safety of Nuclear Critical Assemblies). Kozlov, V. F.; Shishkin, G. V. Moscow, Atomizdat, 1969. 176p.

Nuclear critical assemblies (uranium-water and uranium graphite reactors), radiation conditions, permissible doses, and measures for neutron- and γ radiation protection are discussed in the first and second chapters. Dosimetric control, and instruments for detection and measurements of γ- and neutron doses are described in the third chapter. Individual dosimetric control of small chronic doses, emergency dosimetric control, and measures for securing nuclear and radiation safety are covered in the last three chapters. (102 references are included). (R.V.J.)

50566 THE PROBLEM OF RADIOPROTECTION. I. PROBLEMS OF PERSONAL AND ENVIRONMENTAL RADIATION-PROTECTION IN RADIOTHERAPY DEPARTMENTS. Marceca, I.; del Buono, G.; Longo, F.; Salamanna, S. (Univ., Bari, Italy). Ann. Sanita Pubblica, 28: 123-34(Jan.-Feb. 1967). (In Italian).

Statistical data concerning wards and sections where radioactive substances are used are evaluated. The Decree n. 185 of February 1964 is discussed, with particular reference to the concept of controlled area for professionally exposed persons. (auth)

Safety Procedures

Refer also to abstracts 50197, 50539, 52073, 52102, and 52395.

50567 (AD-685997) HANDBOOK ON RADIATION SAFETY. Kozlov, V. F.; Troshkin, Yu. S. Translated from pp 1-277 of Spravochnik po Radiatsionnoi Bezopasnost, Moscow, 1967. 271p. (FTD-MT-24-243-68). CFSTI.

Problems of radiation safety in institutions and plants handling radioactive substances and sources of ionizing radiation are described, and a systematic presentation of the principles and responsibilities for organizing dosimetric controls and other protective measures is given. Tabulated data on radiation doses and their biologic effects, and on dosimetric calibration equipment are presented, and dosimetric methods are explained. Rules and principles for the safe transportation of radioactive materials and the removal of radioactive waste are given. The handbook is intended for scientific workers, engineers, and members of the dosimetric control service in institutions and plants dealing with radioactive substances and sources of ionizing radiation. The presented data were compiled from Soviet and foreign literature published up to 1966. (auth) (USGRDR)

50568 (N-69-31500) SOME CONSIDERATION OF SAFETY HANDLING OF X-RAY DIFFRACTION APPARATUS. Konishi, Emiko; (and others). Translated from Hoken Butsuri, 2: 57-66(1967). 14p. (NASA-TT-F-12310). CFSTI.

Some practical considerations of safety handling of x-ray diffraction apparatus are presented. The following points are mentioned: most accidental hazards result either from mishandling or careless use; regulations are inadequate at present; and interest

in safety control is inadequate. Monitoring and survey techniques were investigated in detail, and it was suggested that qualitative monitoring of leakage and scattered radiation is more important than quantitative dose rate measurements. It is shown that unnecessary radiation exposure of operators occurs mainly in the process of tube adjustment and sample positioning. (auth) (USGRDR)

50569 (PHS-999-RH-33, pp 87-96) PREVENTIVE MEDICINE IN THE ATOMIC ENERGY INDUSTRY. Evans, D. W. S. (Atomic Energy of Canada Ltd., Chalk River (Ontario)); Stewart, C. G.; Marko, A. N. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.).

The prevention of injury to employees from exposure to ionizing radiation is considered; the Atomic Energy of Canada Limited was used as an example to show how this matter is dealt with in Canada. The complexity and size of the entire organization is illustrated in diagrammatic form. The duties of the subsections of the Radiation and Industrial Safety Branch, Protective Services Branch, Medical Branch, Waste Disposal, and the Biology and Health Physics Division are outlined and discussed. (C.O.)

50570 (PHS-999-RH-33, pp 97-107) RADIOACTIVITY HAZARDS IN EXPLOITATION OF NATURAL RESOURCES. Archer, Victor E. (Occupational Health Field Station, Salt Lake City, Utah).

Uranium miners were examined periodically between 1950 and 1960; results of the epidemiological analysis of these medical findings and the interesting associations were studied. Associations of age, years of underground uranium experience, and smoking in relation to pulmonary disorders tended to be directly related to years of underground experience. The incidence of lung cancer in uranium miners was studied; the histological findings are described. Consideration is then given to content of ^{210}Pb in bone versus cumulative exposure, ratio of ^{210}Pb in urine versus bone, and the effect of excretion on cumulative exposure. Methods of measuring lung cancer in uranium miners are discussed. (C.O.)

50571 (PHS-999-RH-33, pp 108-11) PREVENTIVE MEASURES IN EXPLOITATION OF NATURAL RESOURCES. Holaday, Duncan A. (Occupational Health Field Station, Salt Lake City, Utah).

Uranium miners are exposed to all of the occupational hazards that are generally present in underground mining operations such as silica dust, toxic smokes, and gases from the use of explosives; diesel engine exhaust gases; excessive noise; and a variety of physical hazards. Additionally, uranium miners are exposed to external β and γ radiation from the ore bodies, and internal radiation from airborne radioactive elements that are inhaled and deposited in the respiratory tract. Usually, the hazard from external radiation is minor compared with that from internal radiation, and the primary internal radiation hazard is created by exposure to ^{222}Rn and its short-lived daughters. An understanding of the physi al and radioactive properties of radon and its daughters is necessary before it is possible to assess the problems involved in controlling contamination of working areas in mines by these elements and to design useful control procedures. (auth)

50572 (PHS-999-RH-33, pp 153-6) RADIATION ACCIDENTS. Thoma, George E. Jr. (Saint Louis Univ., Mo. Dept. of Internal Medicine).

The types of radiation accidents that have occurred in the field of nuclear technology since its formal beginning in 1945 are reviewed and discussed. Radiation accident, nuclear technology, minor accident, and major accident are defined. Source of the radiation exposure (internal or external), minor accidents (contamination), and major accidents (experimental assembly accidents, reactor accidents, and production facility accidents) are emphasized in relation to accident causes and management of the cases (involving both health physics and medicine). (C.O.)

50573 (PHS-999-RH-33, pp 157-9) INDUSTRIAL EXPOSURE TO RADIATION. Villforth, John C.; Boggs, Richard F. (National Center for Radiological Health, Rockville, Md.).

The effective radiation control program of the AEC for people employed in atomic energy work is discussed. However, it is mentioned that a large group of workers are exposed to radiation incidental to their primary occupation (radiologists, x-ray technicians, dentists, etc.) and that a radiation control program is needed; the advances made in this area are discussed briefly. (C.O.)

50574 ATTAINMENTS OF SOVIET RADIATION LABOR HYGIENE. Parkhomenko, G. M. Gig. Sanit., No. 12, 31-4 (Dec. 1968). (In Russian).

Radiation protection standards and training programs for industrial personnel using ionizing radiations and radioactive substances in the Soviet Union are reviewed. Research programs in health physics are discussed. (C.H.)

50575 SAFETY AND NATIONAL SECURITY. Laurence, G. C. (Atomic Energy Control Board, Ottawa). Can. Mining Met. Bull., 62: 616-18(June 1969).

The hazards and extensive precautions taken in Canadian uranium mines, concentrating plants and processing plants are discussed. Canadian policy regarding the control of the sale and distribution of uranium and other nuclear materials is also outlined. (auth) (Canada)

50576 ON THE MEDICAL CONTROL OF PERSONS OCCUPATIONALLY EXPOSED TO RADIATION. Zix, R. (Univ., Freiburg i. B.). Zentralbl. Arbeitsmed. Arbeitsschutz, 18: 179-81(June 1968). (In German).

Physical examination of 520 individuals working with radioisotopes, some of them in high-hazard areas, showed no indication of radiation injuries. Hematological values varied to such a degree that they could not be used as indicators for minor radiation effects. Reexamination of persons in six months intervals appeared unnecessary; yearly surveillances were advised. Both for statistical evaluation and for research purposes, a central depository for radiation health information was recommended. (H.B.G.)

50577 HOW SAFE ARE MICROWAVES? Murray, R.; Abraham, J. D. R.; Chambers, J. H.; Elliott, P. M.; Ffrench, G. E.; Gilbert, P. R.; Holden, H.; Muirhead, A. (Trades Union Congress, London). Non-Ioniz. Radiat., 1: 7-8(June 1969).

A series of questions derived from discussion among a group of industrial physicians who in the course of their work have been asked to give advice about exposure to microwaves is considered. Those who can answer any of these questions, both in a quantitative and qualitative way, are invited to send answers. Interesting and helpful replies will be considered for publication. (auth) (UK)

Civil Defense

Refer also to abstracts 50397, 50398, 50458, and 50888.

50578 (CONF-671135) PROCEEDINGS OF THE SYMPOSIUM ON POSTATTACK RECOVERY FROM NUCLEAR WAR, FORT MONROE, VIRGINIA, NOVEMBER 6-9, 1967. (Office of Civil Defense, Washington, D. C. Office of Emergency Planning, Washington, D. C. National Academy of Sciences-National Research Council, Washington, D. C.). Apr. 1968. 434p.

Separate abstracts were prepared for 27 papers of this conference. One paper has appeared previously in NSA. In addition, the conference included summary statements by the chairman of each session: sustenance, health, long-range effects, prospects for economic recovery, economics, and societal vulnerabilities. (C.O.)

For abstracts of individual papers see: 50397, 50398, 50458, 50579-50601, and 50888.

50579 (CONF-671135-, pp 9-20) EXAMPLE ATTACKS. Pettee, James C. (Office of Emergency Planning, Washington, D. C.).

A general exposition of the major characteristics and dimensions of the effects of two quite different attack problems was presented. The purpose was to provide a specific framework for subsequent symposium presentations when it was desired to relate them to specific illustrative cases. It was also intended to supplement the presentation of the scenario in creating the atmosphere and general frame of reference for the whole series of symposium discussions. (auth)

50580 (CONF-671135-, pp 23-41) FOOD CROPS AND POSTATTACK RECOVERY. Shinn, A. F. (Oak Ridge National Lab., Tenn.).

A dramatic fall in the commodity reserves of the United States has occurred, while the level of nuclear threat has increased. Estimates of the national food supply on July 1, 1967 are given, including farm animals, farm crops, fish, grain stocks, stockpiles, and wildlife. This supply would presumably last about 16 months. Ways of using the grain reserves in an emergency are suggested and emergency backup supplies for protein in case of severe depletions of livestock are recommended. Problems of distribution and seasonal variations are also considered. (C.O.)

50581 (CONF-671135-, pp 43-58) LIVESTOCK AND POSTATTACK RECOVERY. Bell, M. C. (Tennessee Univ., Knoxville).

After major disasters, food supplies and food production have played important roles in recovery. Livestock in the United States valued at $19 billion are a major food reserve item of significance to postattack recovery. Our food reserve of cattle, valued at $16 billion, thrive on feeds not suited for man and they also help to screen out dietary undesirables such as radioactive fallout.

Livestock-survival estimates for CIVLOG-65 are similar to human-survival estimates. These estimates of survival of livestock might be much lower if consideration is made for the interaction of gamma radiation with other insults such as: blast and thermal effects; gastrointestinal and skin damage; and deprivation of feed and/or water. The productive life of livestock surviving a thermonuclear attack would probably not be materially affected provided the necessary production inputs were supplied. Guidelines are needed to help establish levels of radioactivity in livestock products which would be acceptable for human consumption in postattack recovery. (auth)

50582 (CONF-671135–, pp 59-64) FACTORS LIMITING POSTATTACK AGRICULTURAL RECOVERY. Park, A. B. (Department of Agriculture, Washington, D. C.).

An epidemiological study of those factors limiting postattack agricultural recovery was made. Blast and thermal effects were considered as host agents and radiation as a multiple host agent. A fourth disruptive agent, denial time, was also considered. The relative disposition of cereal and cereal products, eggs, fats and oils, fruits and vegetables, meat and meat alternates, milk and dairy products, potatoes, and sugar, syrups, honey, and other sweets in the event of nuclear attack is discussed. (C.O.)

50583 (CONF-671135–, pp 67-91) SIMULATION MODEL OF AN EMERGENCY MEDICAL SYSTEM. Hallan, J. B. (Research Triangle Inst., Durham, N. C.).

A computer simulation model was developed to determine the effectiveness of alternative medical-support systems in the immediate postattack period. The model allowed an in-depth examination of the problems of allocating scarce medical resources among overwhelming demands caused by the direct-effects caseload. All essential elements of an emergency medical-support system needed in a community are described. Descriptions are presented of the input data required by the simulation program that were as follows: injury caseload, prognoses, preferred and actual level of treatment, priority rule, and community medical resources. The apparent lack of interaction among the variables studied implied that the addition of resources of any type tended systematically to increase survivors, independent of the level of, or changes in, other resources. (C.O.)

50584 (CONF-671135–, pp 93-8) PREVENTING THE PREVENTABLE. Sencer, David J. (Public Health Service, Washington, D. C.).

Communicable disease control in the postattack era is discussed from two different viewpoints: the modification of the human population by radiation and the modification of the total environment (biological, physical, and social) by the disaster. Disease problems brought about by crowding, displacement from a normal place of living, and primitive resources needed by persons with 20th century mentality are outlined. It was concluded that the motivation of society rather than the technology of communicable disease control is the most important factor in preventing the preventable. (C.O.)

50585 (CONF-671135–, pp 99-102) PUBLIC HEALTH SERVICE VIEWS ON POSTATTACK MEDICAL PROBLEMS. Huntley, Henry C. (Public Health Service, Washington, D. C.).

Discussions are presented of the three things considered important in the postattack situation (in terms of resources): health manpower (physicians and allied professions), expendable resources (pharmaceutical and medical and surgical supplies), and facilities for treating the patient. The role of the computer in predicting the outcomes of the various approaches to the solution of postattack health problems is emphasized. It was concluded that a computer simulation model with varying inputs provides a flexible tool for estimating the differences made by varying types of organizations and varying amounts of the three main resources, facilities, manpower, and supplies. (C.O.)

50586 (CONF-671135–, pp 107-35) FORECASTING LONG-RANGE ECOLOGICAL RECOVERY FROM NUCLEAR ATTACK. Osburn, William S. Jr. (Atomic Energy Commission, Washington, D. C.).

A review of studies of ecosystems irradiated with lethal doses of ionizing radiations (from nuclear testing or stationary gamma sources in natural areas) indicated that ecological recovery followed pathways of succession that were predictable and similar to those following recovery from other catastrophic events, such as fire. Included in the review were studies of the Cape Thompson region in Alaska, of ecosystems at the Oak Ridge and perhaps the Brookhaven National Laboratories, and of the Battelle-Northwest and Savannah River ecology groups, as well as another mountain watershed. (80 References) (C.O.)

50587 (CONF-671135–, pp 171-9) DECONTAMINATION OF FOOD AND WATER FOLLOWING NUCLEAR ATTACK. Straub, Conrad P. (Minnesota Univ., Minneapolis).

Data from studies of environmental contamination contributed through fallout and from laboratory and field-type tests and data on the efficacy of water and sewage treatment processes for the removal of radioactive materials are reviewed. Food decontamination in relation to farm practices, chemical treatment, and processing effects are considered. Water decontamination is briefly discussed. It was concluded that emergency treatment methods for water were more effective for the removal of fission-product isotopes than were conventional treatment processes; use of stored feed of lower activity was by far the most satisfactory method of reducing contamination in milk. (27 References) (C.O.)

50588 (CONF-671135–, pp 181-9) LONG-RANGE BIOLOGICAL EFFECTS ON MAN OF NUCLEAR ATTACK. Dunham, Charles L. (National Academy of Sciences, Washington, D. C.).

Long-range biological effects of nuclear attack on man are discussed. Topics included were incidence of miscellaneous tumors, leukemia, thyroid adenomas; effects on skin; radiation cataracts; immunity; effects on average life span; and cytogenetic and genetic effects. It was concluded that in the surviving population, the effect will be a minor perturbation coming after a truly catastrophic event and that during a long time period this will be lost in the background of increasing disease-incidence rates and mortality rates from other causes. (C.O.)

50589 (CONF-671135–, pp 191-2) LONG-RANGE EFFECTS OF RADIATION. LeRoy, George V. (Metropolitan Hospital, Detroit, Mich.).

The clinical care of man exposed to radiation following a nuclear attack is briefly discussed. Particular emphasis is placed on those whose exposure would be protracted over weeks or months. The most serious problem was considered to be development and enforcement of guidelines that conserve medical manpower and medical supplies. (C.O.)

50590 (CONF-671135–, pp 199-203) RADIATION CARCINOGENESIS IN SURVIVORS OF NUCLEAR ATTACK. Casarett, George W. (Rochester Univ., N. Y.).

A projection of the possible carcinogenic effects of radiation exposure in survivors of nuclear attack is presented in terms of absolute risk estimates, i.e., in terms of the number of additional cases of cancer per million persons exposed to a unit dose (rad). Data were taken from studies on survivors of the atomic bombings of Hiroshima and Nagasaki and from people exposed to medical radiation. Risk estimates are given for leukemia, cancers other than leukemia (combined), and thyroid cancer. Risks from internally deposited radioisotopes are also discussed. (C.O.)

50591 (CONF-671135–, pp 207-16) NATIONAL ENTITY SURVIVAL FOLLOWING NUCLEAR ATTACK. Laurino, Richard K. (Stanford Research Inst., Menlo Park, Calif.).

A series of indirect indicators were used to reflect the condition of essential elements (population, resources, and institutions) and the condition of a nation following an attack was considered. Examinations of postattack recovery capabilities were made for a small number of attack conditions. It appeared that national survival and recovery could be achieved providing efficient use was made of remaining resources. Heavier attacks or attacks designed to induce imbalances in national elements could reduce the population's confidence in achieving survival and recovery. Regardless of the attack scale and design, it was concluded that there is a definite need for planning and implementation of postattack procedures. (C.O.)

50592 (CONF-671135–, pp 217-29) SURVIVAL MODEL OF POSTATTACK PHYSICAL CAPACITIES. Sobin, Bernard (Research Analysis Corp., McLean, Va.).

A post-nuclear attack physical survival model is described. The description covers technical characteristics of the model in terms that show the place of the model in the family of economic models that exist for similar purposes. It also covers some of the present uses of the model and improvements that would make it more useful. (C.O.)

50593 (CONF-671135–, pp 231-42) POSTATTACK VIABILITY OF THE UNITED STATES, 1975. Addington, Lloyd B. (Office of the Chief of Engineers, Washington, D. C.).

Attempts were made to estimate the effects of a nuclear attack on the United States in 1975. Projections were made for both the population and the labor force, showing a greater increase in the latter. Consideration was given the changing mix of skills and the geographic distribution of skills and industry. The Gross National Product was also projected to 1975. About ½ of the

land area would be undamaged by blast, fire, or lethal fallout by the estimates. These areas would be primarily outlying areas and would contain over 20% of the population and industry. Viability estimates considered the physical-plant capacity as well as the production capability. By increasing labor utilization in the surviving population, there would be excess manpower (over that usable in remaining industry capacity) for military utilization. Redirecting production from consumer goods to military products would also aid the military effort that might be necessary. It was concluded that the capability exists for emerging from a holocaust and maintaining a dominant position in the world. (C.O.)

50594 (CONF-671135–, pp 245-73) ESTIMATES OF THE POTENTIAL OF THE UNITED STATES ECONOMY FOLLOWING A NUCLEAR ATTACK IN 1975. Bickley, L. J.; Pearsall, E. S. (Institute for Defense Analysis, Washington, D. C.).

Data are presented for results of a study of postattack economic potential of the United States. Results would seem to indicate a reasonably high standard of living following attack. Measures to protect population would increase postattack value-added. From this model it is concluded that a general system of production and consumption controls would not be desirable. The input-output analysis deals in tangible capacities and damage can be assessed in such terms. The intangibles, such as damage to the free-market system or the overall financial and credit structure, cannot be measured. (C.O.)

50595 (CONF-671135–, pp 275-89) RESOURCES MANAGEMENT. Livermore, Shaw (Arizona Univ., Tucson).

The history and evolution of thinking and planning for post-nuclear-attack resources management in the United States are discussed. Ten specific areas are suggested for research. These include: industrial damage assessment; identification of long-lead-time equipment (such as machine tools); historical methods for quick restoration of low-level output (such as petroleum or drugs); rationing methods for food and other basic necessities; behavioral response of populations; problems of broken chains of production; utilization of the construction industry; utilization of cargoes in harbors; judgment in news and data releasing; and responses and motivations of people under postattack conditions. (C.O.)

50596 (CONF-671135–, pp 291-5) THE PROBLEM OF EVALUATING AND DISTRIBUTING SURVIVING POSTATTACK ASSETS. Peskin, Henry M. (Office of Emergency Planning, Washington, D. C.).

The problems in the valuation and distribution of surviving material assets after nuclear attack are explored without reflecting any existing governmental policy. The legal question (ownership, inheritance, etc.), the moral question (extremes in state of survivors from untouched to destitute and unknown extent of generosity in that situation), and the economic question (radical change in real values of surviving assets, optimality, planning production over time) are discussed. Policy possibilities in the extremes are institution of a free, unfettered market economy and institution of an admittedly nondemocratic, centralized system of control. A middle position involving the necessity of some centralized authority for some time, but restoration of a freer market economy as soon as possible is advocated. Workable plans would have to be flexible, mindful of the legal, moral, and economic problems, simple, easily administered, and capable of being activated without extensive training of bureaucrats. The popularity of these plans with the public is discussed in relation to both the pre- and post-attack situations. (C.O.)

50597 (CONF-671135–, pp 297-310) FEDERAL ROLE IN POSTATTACK ECONOMIC ORGANIZATION. Winter, Sidney G. Jr. (RAND Corp., Santa Monica, Calif.).

In addition to killing and injuring a great many people, and destroying or damaging vast amounts of property, a nuclear attack on the United States would produce enormous confusion and chaos, particularly in the realm of economic activity. The disruption produced by an attack would have effects as serious as those of the outright destruction. More than Pearl Harbor, more than the most massive invasion by conventional armies, nuclear attack would break the threads of economic continuity. The survivors will not find it helpful in their decision making to compare the first three months after a nuclear attack with the same quarter last year. Neither will they, in looking ahead, have any confidence in whatever picture of the future they are able to form. Economic life is coordinated and regulated by the basic institutions of private property and voluntary exchange, the facilitating institutions dealing with money and credit, and the invisible hand of market forces. In the aftermath of a nuclear attack, the legal ownership and control of a substantial fraction of the nation's surviving real wealth would be left uncertain by the destruction of records, the collapse of normal processes of estate settlement in the face of millions of deaths, and the chaos introduced into balance sheets by the massive and haphazard destruction of wealth. The elaborate system of organized commodity exchanges would be hard hit, and markets of all kinds would suddenly be fragmented by the breakdown of communications and transportation. Equally fundamental are the legal and political institutions that make, modify, and enforce the rules of the economic game. Contracts are usually performed and checks are usually redeemed, but when they are not, the law and the courts are there. It goes without saying that nuclear war would increase enormously the volume of problems of these kinds to be handled, at the same time increasing the urgency of solution, and destroy a substantial portion of the people, records and facilities normally involved in finding solutions. Finally, the functioning of the economic system is shaped to some extent by a varied assortment of economic regulation and control mechanisms imposed by governmental units at all levels, and by taxation systems that serve partly as regulatory devices and partly to finance the government. Here, no less than in the other cases, a substantial nuclear attack would take a heavy toll. Expertise, records, and facilities relevant to the old tasks would be casualties. Much of the information and expertise that does survive will relate to the preattack world, and not at all to the postattack world. This is the problem of postattack economic organization. Institutions and mechanisms in each of these four categories would be severely shaken by a nuclear attack. (E.R.B.)

50598 (CONF-671135–, pp 313-26) DEMOGRAPHIC ANALYSIS AND SOCIETY AFTER A NUCLEAR ATTACK. Pendleton, William W. (Emory Univ., Atlanta, Ga.).

The demographic changes associated with nuclear attacks are quite different from those that occur in society during normal periods. Ordinarily, demographic changes occur slowly—over decades. Since nuclear war could lead to more dramatic changes in the population of the country than any it has experienced in so short a time, the determination of what those changes might be and how anticipating them could be advantageous in expediting recovery and designing countermeasures were investigated. (E.R.B.)

50599 (CONF-671135–, pp 327-63) SOCIAL INDICATORS OF SOCIAL EFFECTS AND THE SOCIAL INVENTORY AFTER ATTACK. Vestermark, S. D. Jr. (Human Sciences Research, Inc., McLean, Va.).

Enough knowledge of probable social effects of nuclear attack now exists to justify a much broadened inquiry into what they may be under a full variety of conditions. For this reason, the prospects and requirements for learning more about social effects were emphasized. An important subsidiary theme was that the development of postattack social knowledge will be closely tied to developments in general knowledge about human behavior and society. The special nature of the postattack social research as a basis for potential postattack social management can be more clearly understood if two concluding cautionary notes are kept in mind. A nuclear attack of significant scale would create rapid changes in the values of many social variables. For this reason, old data baselines would be less relevant than new baselines drawn from postattack conditions. Of particular significance would be the capability for conducting trend analyses of changes, based on studies of postattack panels of individual respondents. It is conceivable that the preattack development of a system of social indicators would represent a commitment to analytic constructs and measures that could prove less relevant than expected to managing postattack social conditions. For this reason, there must be the possibility of redefining social variables and indicators on the basis of postattack experience. One of the most subtle challenges postattack officials may face is to be able to modify the fundamental intellectual tools with which they approach a stressful reality, without losing a sense of the necessary relations this reality has with a preattack world. (E.R.B.)

50600 (CONF-671135–, pp 365-73) POSTATTACK ORGANIZATIONAL PROBLEMS AND SOCIETAL VULNERABILITY. Dresch, Francis W. (Stanford Research Inst., Menlo Park, Calif.).

Further support is given to the general conclusions regarding postattack organizational problems and societal vulnerability presented in this summary. The pricing problem confronting any agency concerned with recovery management—the problem of estimating real costs and benefits involved in trade-off analysis of alternatives—runs throughout these studies as a major methodological obstacle to definitive quantitative recommendations. The lack of an established theory and body of knowledge concerning the formation of beliefs, attitudes, values, and opinions of segments of the population is an all-persuasive methodological

obstacle to a full discussion of societal vulnerability. While the latter problem reduces confidence in predictions of the postattack evolution of familiar institutions, the pricing problem is likely to be of greater concern to harassed decision makers in the aftermath of any nuclear attack. (auth)

50601 (CONF-671135-, pp 375-93) REORGANIZING AFTER NUCLEAR ATTACK. Brown, William M. (RAND Corp., Santa Monica, Calif.).

Problems of reorganization following a nuclear attack include the fact that: Even though a major fraction of the physical resources survive a nuclear attack, the economic viability of the country is not assured. The purpose of preplanning for a civil-defense mobilization is to enable it to proceed rapidly and effectively at the time it is needed. The appropriate balancing of crisis activities includes the option to create a large emergency organization that could be indispensable if we wish to assure an effective postattack economic reorganization. Another great threat to an effective reorganization following a nuclear attack is the collapse of federal currency—that is, a nearly complete loss of confidence in the dollar. It is suggested that preventive actions could include an option to seize the food industry, i.e., nationalize it, and, if needed, to operate it during the reorganization period as a temporary federal institution. In addition to seizing the food industry, it is argued that during a crisis period the federal government could begin rapidly building up stockpiles of survival supplies other than food, e.g., petroleum, metals, chemicals, medical supplies. In order to provide a solid basis for an industrial role in a mobilization for postattack recovery, local studies are needed in selected industries to uncover their potential for emergency responses within days, weeks, or months. These studies are needed to understand; the utility of protective measures to reduce vulnerability, the utility of preattack emergency stockpiling of raw materials and finished products, and the potential of developing talented groups that, through the performance of these emergency functions during a crisis, would provide the large number of experienced personnel needed for a paragovernmental organization that would manage the postattack reorganization. The Movement to Shelter program options, as now conceived, have some special advantages for postattack recovery. They provide a better estimate of postattack population distribution; encourage the creation of emergency protected stockpiles of food and recovery supplies; provide, in crises of longer duration, an opportunity to solve many distribution problems that would crop up postattack; and provide an unusual opportunity for deeply involving local, state, and federal government agencies in preparations for reorganization and recovery. The complex problems involved in researching and analyzing the requirements for planning a mobilization effort that would greatly enhance the viability of the U. S. economy by rapidly effecting a reasonable postattack reorganization may require substantial funding ($ millions, annually) for a decade. It is recommended that this aspect of postattack research should be strongly emphasized in forthcoming years. (E.R.B.)

50602 NUCLEAR DISASTER. Young, R. B. Queensland Nurses J., 10: 29-30(May 1968).

Personal protective measures that should be taken by all citizens in the event of a nuclear attack are outlined. Diagrams and discussions are presented that detail how depressions in the ground or a gutter can be used, use of brick walls, paper, and rubbish for protective covering, evacuation measures, and underground structures. Facilities for residents within a fallout shelter are also discussed. (C.O.)

50603 FARM SURVIVAL AFTER NUCLEAR ATTACK. Tankersley, H. C.; Wells, Wade G. (Univ. of Idaho, Moscow). Idaho Univ. Ext. Idaho Curr. Inform. Ser., No. 59, 4p.(Oct. 1967).

The protection of livestock in the event of nuclear attack is discussed. The importance of livestock for the survival of people living outside the immediate target zones and in rural areas is stressed. It is pointed out that it may not be practical to provide shelter for all farm animals, but that adequate planning will assure shelter, food, and water for a limited number of animals during the emergency period. Priority for protection should be given to breeding animals first, second for production animals, and third for market animals. The protective factors for various farm structures are listed. It is pointed out that animals can go without water for about 48 hr and without food for about one week. Adequate ventilation is needed in the structures to remove moisture produced by the animals. Since radiation decays rapidly after about 48 hrs, limited outdoor work can probably be done on the third day following a nuclear attack. The emergency radio network will furnish information on radiation intensities and the time individuals can safely work outside shelters in various geographical locations. (C.H.)

Legal Aspects

Refer also to abstracts 50556, 50564, 50566, and 50919.

50604 LASER SYSTEMS: RECENT LEGISLATION, USERS, AND RISKS. Ill. Med. J., 135: 85-6(Jan. 1969).

The Illinois Laser System Registration Act became effective January 1, 1968. This law, the first of its kind in the nation, fixes responsibility in the Illinois Department of Public Health for the registration of all laser systems in the state, to investigate and inspect such systems, to require reporting of any accidental injuries sustained by such laser systems, and to provide injunctive relief for violation of the act. Under the present statute, there are no controls for prevention of hazards but the act merely allows the Department to locate these systems and study the potentials for hazards associated with their use. It is pointed out that lasers present a potential occupational health risk, and as such, the personnel employed in working with lasers should be subject to medical attention. A preoperational or pre-employment ophthalmological examination including a retinoscopy should be made and recorded as a basic picture from which to compare findings at future examination. These records of findings can serve as evidence in disputed cases of eye injury and also as a check on gradual eye injury due to repeated eye exposure to laser bombardment. Routine periodic examinations also should be carried out at intervals of six months or as judged by the plant physician. (C.H.)

50605 REPORT OF COMMITTEE IV ON EVALUATION OF RADIATION DOSES TO BODY TISSUES FROM INTERNAL CONTAMINATION DUE TO OCCUPATIONAL EXPOSURE. ICRP Publication 10. Oxford, Pergamon Press Ltd., 1968. 94p. 30s.

A study carried out between 1964 and 1966 constitutes an amplification of paragraph 86 of ICRP publication 6. Having provided some definitions, the Committee deals with the following aspects: metabolism of radionuclides (entry into the body, translocation and deposition, elimination); monitoring methods and programs; calculation of radiation dose; indications on the manner of investigating doses (investigation levels, derived investigation levels, etc.). Ample references are given under each heading. In addition, there are three reference appendices covering tabulation of metabolic information from ICRP publications 2 and 6; mathematical formulas for calculating radionuclide retention, and data on individual radionuclides. (Occup. Safety and Health Abstr.)

50606 RADIATION MONITORING ACT. Fortn. Rev. Chicago Dent. Soc., 56: 8-9(Oct. 15, 1968).

The details are presented of an act to require employers to provide a type of personnel radiation monitoring service acceptable to the Department of Public Health for those employees subject to radiation monitoring and to report the personnel radiation exposure records furnished by such service to the Department of Public Health. The act also prohibits the operation of film badge radiation monitoring service without approval of the Department of Public Health. (F.M.M.)

50607 RADIATION STANDARDS FOR URANIUM MINING. HEARINGS BEFORE THE SUBCOMMITTEE ON RESEARCH, DEVELOPMENT, AND RADIATION OF THE JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES, NINETY-FIRST CONGRESS, FIRST SESSION, MARCH 17 AND 18, 1969. Washington, D. C., Joint Committee on Atomic Energy, 1969. 419p. GPO $1.50.

Representatives of the Atomic Energy Commission, the Federal Radiation Council, and the Departments of Labor and Interior were requested to testify at this Hearing. Statements were also heard from witnesses representing the American Mining Congress; the AFL-CIO Committee on Atomic Energy and Natural Resources; the Department of Health, Education, and Welfare; the United Steelworkers of America; small uranium mine operators; and various expert witnesses. Topics discussed included radiation safety requirements for uranium miners; the relation of these standards to results of epidemiological studies that provide the scientific basis for radiation safety standards for uranium miners; and the statutory role of the Federal Radiation Council in establishing guidelines for radiation protection in uranium mining, as well as in other areas of radiation exposure. The economic feasibility and health benefits of observing maximum permissible radon exposure standards established by the Department of Labor for uranium miners was also discussed. (C.H.)

50608 MICROWAVES, LASERS, AND X-RAYS. ADVERSE REACTIONS DUE TO OCCUPATIONAL EXPOSURES. Terrill, James G. Jr. (National Center for Radiological Health, Rockville, Md.). Arch. Environ. Health, 19: 265-71(Aug. 1969).

From 28th Annual AMA Congress on Occupational Health, New York. See CONF-681066.

Even though microwaves, lasers, and x radiations appear to have many diverse aspects, all must be studied with reference to certain types of parameters which include the number and types of people exposed, presently and potentially. There is need for adequate measurement systems to place radiation effects research on a quantitative basis and to determine the exposure of human populations as well as creation of a set of standards related to exposure, at home and on the job, so that a minimum effect will occur consistent with the associated benefits. Control techniques must be required, and standards and studies must be reassessed in the light of human experience. (auth)

Medicine

Refer also to abstract 50822.

50609 (TID-3319(Suppl.1)) NUCLEAR MEDICINE. Bibliography from Nuclear Science Abstracts, Volume 22. (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). June 1969. 81p. Dep. CFSTI.

The major divisions, radiodiagnosis (395 references) and radiotherapy (394 references), list citations by type of literature, such as books, periodicals, etc. Presented with each citation is the subject indexing used by NSA. In addition, author, corporate author, and subject indexes are provided in separate sections. (C.O.)

50610 DIAGNOSTICA E TEREPIA CON I RADIOISOTOPI. (Diagnosis and Therapy with Radioisotopes). Torino, Edizioni Minerva Medica, 1962. 954p.

The four sections of the book cover the fundamental bases for the applications of radioisotopes in biology and medicine, methods and techniques in the use of radioisotopes, use of radioisotopes in clinical diagnosis, and use of radioisotopes in clinical therapy. (C.O.)

Protective Substances

Refer also to abstracts 49815, 50349, 50422, 50817, 50882, and 50952.

50611 (PHS-999-RH-33, pp 112-15) ROLE OF MARINE PLANTS ON RADIATION PROTECTION. Nakamura, Yositeru (Hokkaido Univ., Muroran (Japan). Inst. of Algological Research).

Based on their ability to concentrate metal ions (particularly Sr) and radioisotopes in seawater, marine algae are now considered important in radiation protection. Alginates prepared from seaweeds suppress intestinal absorption of Sr in many animal species and man. The main areas of distribution of brown algae belonging to the order Laminariales and Fucales are outlined. Areas where seaweed cultivation is carried out are described; laboratory cultivation is mentioned briefly. (C.O.)

50612 INTRA-ARTERIAL EPINEPHRINE PROTECTION AGAINST RADIATION NEPHRITIS. A PROGRESS REPORT. Steckel, R. J.; Tobin, P. L.; Stein, J. J.; Bennett, R. L. (Univ. of California, Los Angeles). Contract AT(04-1)-Gen-12. Radiology, 92: 1341-5(May 1969).

Four selected patients with widespread abdominal cancer were treated with radiation and concomitant arterial epinephrine infusion of one kidney in an attempt to protect the kidney from radiation damage. Although no histologic data are available and lengths of follow-up are limited, one patient showed a disparity in renal function favoring the protected kidney eight months after completing therapy. No complications secondary to percutaneous catheter placement were recorded, catheters having been well tolerated in the renal artery for periods of up to 23 days. (auth)

50613 STUDY OF CHEMICAL RADIOPROTECTION IN IMMUNIZED ANIMALS. Soumerska, T. (Ministry of Public Health, Sofia). Compt. Rend. Acad. Bulg. Sci., 21: 969-71(1968).

Mice were γ-irradiated on the fifth day following immunization with sheep erythrocytes. An equal number of non-immunized mice were irradiated. Before irradiation one half of the mice were given intraperitoneal injections of cysteamine and serotonin. Results indicated that these substances were effective radioprotective agents. With a dose of 750 R there was no difference between immunized and non-immunized animals with regard to radiation effects. With a dose of 820 R radiation injuries were more severe in immunized non-protected animals. (H.L.W.)

50614 PROTECTIVE EFFECT OF FOLCYSTEINE AGAINST ACUTE RADIATION SICKNESS. Oeriu, S.; Herscovici, H.; Singer, D.; Gane, P. (Inst. of Chemotherapy, Bucharest). Arzneim-Forsch., 17: 1336-7(Oct. 1967). (In German).

The radioprotective action of Folcysteine, a folic acid preparation in which a thiazolidinecarboxylic acid group is liberated by an enzyme system, was tested. Its action was compared with that of cysteine and folic acid. The compounds were injected 30 min before x irradiation of rats with 800 R. The 30-day survival rate was 0% in the control and folic acid-treated rats, compared with 8% in the cysteine and 70% in the Folcysteine-treated rats. The doses of cysteine and Folcysteine were each 30 mg/Kg while that of folic acid was 0.6 mg/Kg. Folic acid alone had no radioprotective action. The Folcysteine group showed no hemorrhagic enteritis, that was seen in controls, and the leukocyte count returned to normal in the 30-day period but only to $\frac{2}{3}$ of normal in the cysteine group. The marked bone marrow hypoplasia seen in the controls was not present in the Folcysteine-treated rats. In vivo liberation of the active group is believed to be more effective in radioprotection than a preactivated compound such as cysteine. (BBB)

50615 COMPARATIVE PROTECTION OF HEMATOPOIETIC AND INTESTINAL SYSTEM IN MICE BY ENVIRONMENTAL HYPOXIA AND CHEMICAL COMPOUNDS. Vacek, A.; Sugahara, T. (Kyoto Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 27: 1088-92(Nov. 1967).

In experiments on mice dd/YF, irradiated at 900 R the protective effect of hypoxia and drugs on the weight of intestine and on endogenous spleen colony (ESC) formation after irradiation was studied. The radioprotective drugs and hypoxia increased the mean ESC per spleen independent of decreased oxygen tension in tissues. Sulfhydryl compounds produced better protection of the weight of intestine than increase of the ESC count, while drugs decreasing oxygen tension in tissues protected intestine and increased ESC count per spleen. (NSA of Japan) (TSS)

50616 PHARMACOLOGICAL STUDY OF MECHANISM OF RADIOPROTECTIVE ACTION OF CATECHOLAMINES. Kulinskii, V. I.; Simon, I. B. (Ukrainian Inst. of Post-Graduate Medical Studies, Kharkov. Kharkov Inst. of Endocrinology and Hormone Chemistry). Byull. Eksp. Biol. Med., 67: No. 4, 63-6(Apr. 1969). (In Russian).

In experiments on 1096 white mice irradiated with 685 R the radioprotective action of catecholamines and influence of various adrenolytics were studied. Equimolar doses of adrenaline (1 mg/kg of base) and isopropylnoradrenaline produced equal effect (47% survival rate) and exceeded noradrenaline (28%). Dibenamine (15 mg/kg 19 hours before giving catecholamines) slightly decreased antiradiation effects of adrenaline and isopropylnoradrenaline (up to 30%) but did not influence noradrenaline effect. Inetol (netalid—10 mg/kg given 17 to 30 minutes before) and its combination with dibenamine do not alter the radioprotective action of catecholamines. Anaprilin (propranolol—10 mg/kg 25 to 30 min before) totally blocked effect of isopropylnoradrenaline, but increased adrenaline effect (70% survival rate) up to the level of radioprotective effect of cystamine (150 mg/kg). The above data show that classical adrenoreceptors (alpha and beta) do not play a decisive role in the antiradiation effect of adrenaline and noradrenaline. Other receptors must be involved. Isopropylnoradrenaline acts through beta receptors. (auth)

50617 SUBSTANCES MODIFYING TUMORAL RESPONSE TO RADIATION: EFFECTS OF NAD, HEMATOPORPHIRINE, AND HYDROCORTISONE. Oliva, L.; Stuart, C.; Cittadini, G. (Univ., Siena, Italy). Med. Nucl.-Radiobiol. Lat., 11: 99-109 (1968). (In Italian).

The effects of nicotinamide-adenine dinucleotide (NAD), hematoporphyrin, and hydrocortisone administered alone or together with whole-body x radiation on the growth of transplanted tumors in mice were studied. The administration of NAD alone or combined with x radiation had no effect on the growth of tumors. Hematoporphyrin alone had no effect on tumor growth but had a marked effect on the radiosensitivity of the tumors. Hydrocortisone had a slight inhibitory effect on tumor growth and a marked effect on tumor radiosensitivity when administered before irradiation. (C.H.)

50618 CONTRIBUTIONS TO THE RADIOPROTECTIVE EFFECT OF NITRILES. Hernadi, F.; Nagy, Zs.; Kovacs, P.; Dezsi, Z.; Valyi-Nagy, T. (Medical Univ., Debrecen, Hungary). Acta Biol. Acad. Sci. Hung., 19: 257-67(1968).

The presumed role of the active methylene group in the radioprotective effect of nitriles was investigated by determining the radioprotective effect of 42 nitriles and thiocyanate derivatives, some of them containing an active methylene group, on the survival of x-irradiated Escherichi coli B and C3 mice. (BBB) (TSS)

50619 RADIOPROTECTIVE ACTION OF CYSTEAMINE WITH RESPECT TO RADIATION PRODUCED ALTERATIONS IN THE INTESTINAL ABSORPTION OF GLUCOSE. Lluch, M.; Ponz, F. (Univ. of Navarra, Pamplona, Spain). Rev. Espan. Fisiol., 24: 147-8(Sept. 1968).

Experiments to determine the minimum amount of injected cysteamine necessary to obtain a complete radioprotective effect

in radioinduced inhibition of intestinal absorption of glucose were conducted. Intestinal absorption of glucose was studied in whole-body x-irradiated rats (600 R) at 96 hr postirradiation. Cysteamine is administered intraperitoneally 10 min before irradiation in doses of 1 to 10 mg/100 g. Injection of cysteamine in nonirradiated rats did not affect the active transport of glucose. Irradiation inhibited almost 45% of the active transport. Cysteamine given at levels of 10 and 5 mg/100 g completely protected from the inhibition of absorption, but the radioprotective action was lacking with doses of 1 and 2.5 mg/100 g. Results with the 3.5 mg/100 g dose of cysteamine were interesting since at 96 hr the intestinal absorption of glucose was augmented 40% instead of being inhibited. This result coincided with the effect of a 100 R dose at 96 hr after irradiation, indicating that this amount of cysteamine makes the effect of 600 R equivalent to that of 100 R without cysteamine. A dose reduction factor of about six (600/100) is evident. (BBB)

50620 THE PROTECTIVE EFFECT OF 2-MERCAPTOETHYLGUANIDINE $\frac{1}{2}$ H_2SO_4 AGAINST X-RAY INJURY: DETERMINATION BASED ON DOSE-TESTICULAR WEIGHT CURVE OF THE MOUSE. Okamura, Shigeaki; Nakamura, Hiroshi (Kyushu Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 27: 1501-5(Feb. 1968). (In Japanese).

The protective effect of 2-mercaptoethylguanidine-$\frac{1}{2}$ H_2SO_4 against x-ray injury was studied in relation to weight loss in CF1 male mouse testes. As others have stated that weight loss in the mouse testes results from the sum of the losses in two independently reacting populations, the weight loss was studied in the group irradiated under 190 rad and in the group irradiated over 190 rad. MEG has an excellent protective action against the lethal effects of irradiation, but it is not likely to protect against weight loss in the mouse testes. (NSA of Japan)

50621 THE REMOTE SEQUELAE OF ^{239}Pu INHALATION IN THE PROPHYLACTIC INHALATION OF PENTACINE. Koshurnikova, N. A.; Lyubchanskii. Med. Radiol., 14: No. 9, 29-34 (Sept. 1969). (In Russian).

In experiments on 135 Wistar rats it was demonstrated that for the effects of inhalation of subacute-effective quantities of soluble ^{239}Pu compounds, the prophylactic employment of pentacin (DTPA) inhalation reduced the isotope content of the lungs by four times and in the skeleton by two times in comparison with the unprotected control animals. In the protected animals the average life duration increased by $2\frac{1}{2}$ times in comparison with the nonprotected animals. Increase of the average duration of life was mainly associated with the significant reduction of the spread and markedness of pneumosclerosis. Third-degree pneumosclerosis in protected rats was encountered six times more rarely than in the nonprotected animals. Prophylactic inhalation of pentacin does not change the frequency of occurrence of tumors in the lungs and skeleton, but prolongs somewhat the latent period of their development. (auth)

50622 GLYCEROL ACTION ON RESTORING CAPACITY OF BONE MARROW IN 600 R IRRADIATED DOGS AND ON ABILITY OF NEOPLASTIC OIA AND T8 CELLS IN PRODUCING ASCITES TUMORS. Andrian, T.; Corneci, I.; Buzi, E. (Oncological Inst., Bucharest). Atomkernenergie, 14: 218-20 (May-June 1969).

Bone marrow harvested from 30 dogs before telecobalt radiation (600 R) was stored at 4°C or 25°C in contact with 15% glycerol during 15 min, 1 hr, or 6 hr, when inoculated 24 hr after irradiation. The glycerol influence on the medullar cells was estimated according to their capacity of restoring the γ irradiated animals. The best restoring condition was obtained following 15 min cell incubation with the glycerol. As the contact period was extended the protection capacity decreased progressively; 6 hr of glycerol contact completely destroyed the protecting capacity of the bone marrow. Ascites tumors were stored at 4°C in TC 199 or TC 199 + glycerol. An equal number of cells from two suspensions was administered i.p. in rats, after 15 min, 24 hr, 48 hr, 72 hr, and 120 hr of glycerol contact. The glycerol action on neoplastic cells was estimated by their capacity in producing ascites tumors. Results showed that the neoplastic cells were more glycerol resistant than the normal medullar ones; after 72 hr contact they behaved similarly to the cells stored in TC 199 without glycerol, producing ascites tumors in 100% of the animals. Neoplastic cells suspensions lost their growth capacity only after 120 hr glycerol contact. (auth)

50623 IMMUNOLOGICAL TOLERANCE: THE MODIFIED SELF-RECOGNITION HYPOTHESIS. Uphoff, Delta E. (National Cancer Inst., Bethesda, Md.). J. Nat. Cancer Inst., 42: 255-68(Feb. 1969).

The functional capacity of marrow from donors in which neonatal tolerance had been induced was altered. Marrow from tolerant donors protected more lethally x irradiated allogeneic recipient mice than syngeneic recipients. There were more long-term survivors among allogeneic recipients of tolerant marrow than among syngeneic recipients. Late mortality among syngeneic recipients of either tolerant or preinoculated nontolerant marrow resulted from a syndrome indistinguishable from the secondary disease that resulted from a graft-versus-host reaction. To explain these results a hypothesis was proposed in which immunological tolerance resulted from a modified ability to recognize self and nonself. Although tolerance was not transmitted to progeny of tolerant parents, both the modified ability to recognize self and the ability to be recognized as self were transmitted. These results were discussed in relation to the induction of tolerance by in vitro incubation of marrow with allogeneic erythrocytes before transplantation into lethally irradiated recipients. (auth)

50624 MELITTIN USED AS A PROTECTIVE AGENT AGAINST X-IRRADIATION. Ginsberg, N. J.; Dauer, M.; Slotta, K. H. (Univ. of Miami, Fla.). Nature (London), 220: 1334(Dec. 28, 1968).

It was found by other investigators that the resistance of mice against X-irradiation increased greatly after subcutaneous injection of bee venom, the chief component of which is melittin, a strongly basic polypeptide of molecular weight 2850 and known amino-acid sequence. The present authors conducted some studies with whole bee venom and with purified melittin. The mice were injected 24 hours before irradiation, and all animals subsequently received 850 R. Whereas the whole venom showed inconclusive evidence for protection, the results with melittin were significant. The venom and melittin show high toxicity when injected intravenously or intraperitoneally, but the mice used in the studies survived for at least 30 days after subcutaneous injections with doses as large as 60 mg/kg. Optimal protection could be achieved with about 5 mg/kg. (UK)

50625 CONSIDERATIONS ON THE BIOLOGICAL ACTION OF PROTAMINE SULFATE ON ANIMAL ORGANISMS TREATED WITH ^{32}P. I. ACTION ON SOME FACTORS OF IMMUNITY. Mastroeni, G.; Romano, F. (Univ., Messina, Italy). Med. Nucl.-Radiobiol. Lat., 11: 111-15(1968). (In Italian).

The effects of protamine sulphate on some factors of natural humoral immunity (lysozyme and complement) and cellular immunity in rabbits treated with ^{32}P in different dosage (0.1, 0.5, 2.0, and 4.0 mCi) were studied. The results have showed that pretreatment with protamine sulphate reduces the fall of serum level of lysozyme and of complement and also the leukopenia induced by ^{32}P β radiation when used in doses of 0.1 to 0.5 mCi. (auth)

50626 EXPERIMENTAL STUDIES WITH SOLCOSERYL-TREATED RATS AFTER 750 AND 850 R X IRRADIATION. Szirmai, E.; Teppert, W. A.; Hajdukovic, S. (Univ., Stuttgart). Agressologie, 9: 597-602(1968). (In German).

Experiments with Solcoseryl in rats given the drug either before or after 750 R x irradiation are reported. Liver glycogen, blood sugar, and serum glutamic-pyruvic transaminase (SGPT) were determined 1 day and again at 7 days following irradiation. There was a significant increase in SGPT in the animals receiving Solcoseryl and in those receiving only irradiation. The effect was additive in animals receiving both irradiation and the drug, but the effect appeared to be produced by two different mechanisms. The effect of Solcoseryl on survival was examined in a second series of experiments. There was 52% survival when the drug was injected before 850 R of x irradiation and 42% survival when the drug was injected after irradiation. Thirty days later there was 49% survival in the pretreated group with only 39% in the post-treated one (5% in nonirradiated animals). (BBB)

50627 THE EFFECT OF DIMETHYL SULFOXIDE ON THE SEVERITY OF RADIATION SKIN LESIONS. Hagemann, Ronald F.; Schenken, Larry L.; Evans, Titus C. (Univ. of Iowa, Iowa City). J. Invest. Dermatol., 52: 277-9(Mar. 1969).

Topical application of various concentrations of dimethyl sulfoxide (DMSO) did not result in protection of rat skin against x radiation. Combinations of DMSO and MEA or epinephrine were equally ineffective. High concentrations of DMSO resulted in radiosensitization of the skin. (C.H.)

50628 EFFECTS OF PRETREATMENT WITH SUBLETHAL DOSES OF NITROGEN MUSTARD OR X-RADIATION ON TOLERANCE TO LATER EXPOSURE. Egert, Gundolf; Schuster, Reinhold; Lendle, Ludwig (Univ., Goettingen, Ger.). Strahlentherapie, 137: 675-9(June 1969). (In German).

The increased resistance after repeated x-irradiation could be observed in the same way in rats for the toxicity of trichlorethanolamine (TCEA) after repeated administration. When the lesion caused by the drug was not yet cleared, a new gift resulted in an additive toxicity. Only when the earlier lesions resumed with overshooting reaction of the hematopoietic system (increase of the reticulocytes and leucocytes, relative lymphopenia and splenomegaly) a resistance could be shown against a new dose of the chemical. There seems to be cross-resistance with the resis-

tance induced by irradiation. The lethality of rats after whole-body irradiation (800 R) was reduced after preliminary administration of TCEA, and the toxicity of TCEA was reduced after irradiation. It is assumed that the enhancement of the regeneration within the reactive possibility of the hematopoietic system, and measured by the blood cell count, increases the resistance potential. (auth)

50629 THE EFFECT OF ADMINISTRATION OF LARGE AMOUNTS OF INOSINE ON THE PREVENTION OF LEUCOPENIA IN RADIOTHERAPY. Kanda, Kosuke (Fukuoka Red Cross Hospital). Shinyaku To Rinsho, 18: 385-8(Mar. 1969). (In Japanese).

The prevention of radiation lesions, especially leucopenia, is desirable for the effective use of radiotherapy against malignant tumors. Inosine prevents leucopenia and restores afflicted patients. By raising the ATP level, inosine repairs and protects the other organs. 1200 mg to 1800 mg of inosine were administered daily to patients following ^{60}Co radiotherapy. Satisfactory results were observed in all cases except one where the effect was unknown. (auth) (F.M.M.)

50630 TREATMENT OF X-RADIATION INDUCED DERMATITIS. Kutsenko, A. K. Voenno-Med. Zh., No. 4, 76-8(Apr. 1969). (In Russian).

Upon the irradiation of limited parts of skin with massive doses of x rays, ulcerative-necrotic dermatitis developed with general radiation sickness, expressed by the disturbance of the general state of the animals (reduction of appetite, diarrhea, reduction of weight, change of peripheral blood, etc.). Therapeutic treatment with antireticular cytotoxic serum and cytosine in small stimulating doses reduced the general radiation sickness and had a favorable effect on the development, course, and healing of x-radio-induced ulcerative-necrotic dermatitis. Therapeutic treatment with cytosine alone had less expressed effects but at the same time had a positive effect on the general state of the animals. (auth)

50631 ANOMALOUS EFFECTS OF DIMETHYL SULFOXIDE ON THE RESPONSE OF THE MOUSE LENS AND CORNEA TO X-IRRADIATION: PROTECTION OF LENS AND SENSITIZATION OF CORNEA. Hagemann, Ronald F.; Evans, Titus C.; Riley, Edgar F. (Univ. of Iowa, Iowa City). Radiology, 92: 156-8 (Jan. 1969).

Dimethyl sulfoxide, applied topically to the eyes of mice 8 min prior to head irradiation with 1000 R, prevented complete cataract formation. Although slight lenticular changes were observed in the treated, x-irradiated animals, they did not progress to complete opacification as in the untreated animals. In the same eyes in which the lens was apparently protected, it seemed that the cornea was made more sensitive to radiation damage. (auth)

50632 ATP SYNTHESIS AND RESPIRATION OF RAT THYMUS NUCLEI IN NORMAL AND IRRADIATED ANIMALS. Zhulanova, Z. I.; Kolesnikov, E. E.; Romantsev, E. F. (Inst. of Biophysics, Moscow). Vop. Med. Khim., 15: 396-400(July-Aug. 1969). (In Russian).

The effect of radioprotective drug β-mercaptoethylamine (MEA) on aerobic ATP synthesis and respiration of rat thymus nuclei was studied. It has been shown in vitro that MEA decreases the rate of ATP synthesis during the incubation of nuclei in air. The inhibitory action of drug increases with the increase in MEA concentration. The effect of MEA on respiration has the reverse character — the increase in MEA concentration leads to increase in respiration of nuclei. MEA administration at a radioprotective dose (200 mg/kg) decreases the rate of ATP synthesis, but the respiration remains at the same level. It may be supposed that the effect observed is one of the features of radioprotector. (auth)

50633 PREVENTION AND CONTROL OF SECONDARY DISEASE FOLLOWING ALLOGENIC BONE-MARROW TRANSPLANTATION. Van Bekkum, D. W. (Radiobiological Inst. TNO, Rijswijk, Netherlands). pp 35-45 of Bone-Marrow Conservation, Culture, and Transplantation. Vienna, International Atomic Energy Agency, 1969.

From Conference of Panel on Bone-Marrow Conservation, Culture, and Transplantation, Moscow. See STI/PUB-219; CONF-680721.

A review is presented of the various methods found to be effective in preventing or ameliorating acute secondary disease in rodents and primates. Selective physical elimination of lymphoid cells by centrifugation over a discontinuous albumin gradient, post-transplantation administration of cyclophosphamide, amethopterin or ALS and the selection of histocompatible bone-marrow donors are considered to be the most promising methods in primates. It is not known to what extent delayed secondary disease will occur in monkeys and man in cases where acute secondary disease has been successfully avoided. (auth)

50634 BONE-MARROW STORAGE AND TRANSPLANTATION. Costachel, O.; Corneci, I.; Andrian, T.; Kitzulescu, I.; Popescu, N.; Pascu, D.; Buzi, E.; Voiculetz, N. (Oncological Inst., Bucharest). pp 143-61 of Bone-Marrow Conservation, Culture, and Transplantation. Vienna, International Atomic Energy Agency, 1969.

From Conference of Panel on Bone-Marrow Conservation, Culture, and Transplantation, Moscow. See STI/PUB-219; ONF-680721.

Results from experiments on bone-marrow storage and transplantation are presented. The main problems with preservation of stored bone marrow are the duration, temperature, adjuvant substances and the significance of viability tests during the conservation processes. The results showed that: Storage of bone marrow at +4°C produces a progressive decrease in its restoring capacity versus storage time. While bone marrow stored for 24 hr is able to restore 100% of dogs lethally irradiated with 600 rad, after 10 days of storage only 20% of the animals can be restored. No correlation exists between the actual survival of dogs and that calculated by dye exclusion tests, which indicate a rather high (70%) viability, even after 10 days bone-marrow storage at +4°C. DNA degradation (depolymerization) measurements of the bone marrow may be used as a supplementary test for checking the viability or restoration potency of bone-marrow cells after storage. In the freezing process, the optimum contact time between glycerol and the bone-marrow cells is 15 min. Results of experiments regarding certain bone-marrow transplantation problems showed that: The best time to administer bone marrow is between 24 and 48 hr after irradiation. No survivors were obtained with dogs lethally irradiated with 600 rad by administering autogenic or allogenic DNA extracted from bone marrow, spleen or liver. Histocompatibility related to sex may play an important role in the bone-marrow graft. The lowest survival of C57BL mice was obtained when the donors were males and the recipients females. In radioprotection with foetal haemocytopoietic tissues, the donor's age represents one of the main factors. The best results were obtained in experiments on rats, with 19- to 20-day foetal liver (period of complete and maximum haemocytopoietic activity). The tissues mentioned below may be connected with the appearance of certain typical signs of secondary syndrome. Transfusion of blood or allogenic splenic cells did not influence noxiously the take of autogenic bone-marrow grafts in lethally irradiated dogs. After repeated irradiations and recovery of dogs (1-3 times) following treatment with autogenic bone-marrow, late chromosomal lesions were observed. (auth)

50635 RADIOPROTECTIVE ACTION OF DIHYDROXYPHENYLETHYLAMINE (DOPAMINE) ON WHOLE-BODY X-IRRADIATED RATS. Prasad, Kedar N.; vanWoert, Melvin H. (Univ. of Colorado, Denver. Yale Medical School, New Haven). Radiat. Res., 37: 305-15(Feb. 1969).

The radioprotective action of dopamine on whole-body x-irradiated rats was investigated. Dopamine given immediately before exposure (700 to 1000 R) increased the number of survivors compared to irradiated controls. All irradiated controls died within 12 days after exposure. The spleen and testes of irradiated animals that survived by virtue of dopamine treatment showed a marked recovery. The weight and histologic structures of the spleen and testes of sham-irradiated animals receiving dopamine showed no change compared to normal controls. Dopamine in a single dose or in multiple doses after x-irradiation had no effect on percentage of survivors or survival time when compared to irradiated controls. L-Dopa had minimal radioprotective efficacy, although it had pharmacological effects similar to those of dopamine. Like dopamine, L-dopa was not effective after exposure. (auth)

50636 COMBINED SURGICAL AND RADIATION INJURY. III. THE EFFECT OF PRE-IRRADIATION RADIOPROTECTIVE DRUG TREATMENT. Stromberg, LW. R.; McLaughlin, M. M.; Donati, R. M. (Walter Reed Army Medical Center, Washington, D. C.). Proc. Soc. Exp. Biol. Med., 129: 140-3(Oct. 1968).

The following radioprotective compounds, MEA, serotonin, and S-2-amino propyl (aminoethyl) phosphoric acid, did not alter the wound healing pattern in the nonirradiated rat when wounding followed drug administration by four days. These compounds also did not demonstrate any deleterious interaction with wounding under these circumstances. The radioprotective compounds promoted the wound healing pattern of irradiated, wounded rats toward the pattern of nonirradiated wounded rats. The increased mortality observed with the combination of a nonlethal surgical wound and radiation was not observed in animals treated prior to radiation with the radioprotective agents studied. (auth)

50637 EFFECTIVENESS OF CERTAIN AMINO ACIDS IN CONJUNCTION WITH VITAMINS IN THE CASE OF PROLONGED

IRRADIATION. Zotova, M. G.; Borisov, V. P. (Inst. of Biophysics, Moscow). Radiobiologiya, 9: 567-9(July-Aug. 1969). (In Russian).

It was shown in experiments on white rats that under conditions of prolonged γ irradiation with ^{137}Cs, the use of a complex of vitamins and amino acids prevented the development of acute radiation sickness. A 60% increase in the survival rate of the experimental animals was noted in comparison with the control, along with a substantial reduction of the clinical manifestations of radiation sickness. This preparation is a biological protector in cases of prolonged irradiation. (tr-auth)

50638 PHARMACOLOGICAL PROPERTIES OF RADIOPROTECTIVE AGENTS. (SURVEY). Shashkov, V. S.; Vasin, M. V.; Saksonov, P. P.; Kozlov, V. A. Farmakol. Toksikol., 30: 109-17(Jan.-Feb. 1967). (In Russian).

This survey, with 130 references, reviews the conclusions of Soviet and other authors, published between 1953 and 1966, on the subject of radioprotective agents. The report re-examines the positive, doubtful, and negative results obtained from experiments performed on mice, rats, rabbits, cats, and dogs. Tests included various doses of radioprotective agents, such as S-, β-aminoethylisothiouronium (AET), S-, γ-aminopropylisothiouronium (APT), thiazoline derivatives, β-mercaptoethylamine, γ-mercaptopropylamine, cysteamine, and cystamine, indolylalkylamines, serotonin, 5-methoxytryptamine, and mercamine. Suggested effective doses of radioprotective agents and their mode of action are explained. The toxicity of radioprotective agents, and the effectiveness of the use of detoxifying agents to counteract the toxic effects are discussed. Functions of organs, vessels, and tissues that are either stimulated or depressed by the action of radioprotective agents and detoxifying agents are also considered. (BBB)

50639 INFLUENCE OF GALASCORBIN ON OXIDATIVE PHOSPHORYLATION IN THE MITOCHONDRIA OF THE BRAIN OF IRRADIATED ANIMALS. Shamrai, E. F.; Polyachenko, L. Yu. (Kiev Medical Inst.). Byull. Eksp. Biol. Med., 68: No. 3, 54-7(Mar. 1969). (In Russian).

The influence of galascorbin on the oxydative phosphorylation in the brain mitochondriae of irradiated animals was studied. The data showed that intensity of respiration and phosphorylation in the brain mitochondriae of rats was decreased after irradiation with 600 R. Divergence of oxydative phosphorylation took place. Administration of galascorbin increased oxygen consumption and estherification of inorganic phosphate and led to a rise in phosphorylation coefficient. (auth)

50640 S-2-(ω-AMINOALKYLAMINO)ETHYL DIHYDROGEN PHOSPHOROTHIOATES AND RELATED COMPOUNDS AS POTENTIAL ANTIRADIATION AGENTS. Piper, James R.; Stringfellow, Carl R. Jr.; Elliott, Robert D.; Johnston, Thomas P. (Southern Research Inst., Birmingham, Ala.). J. Med. Chem., 12: 236-43(Mar. 1969).

Twenty-two S-2-(ω-aminoalkylamino)ethyl and S-3-(ω-aminoalkylamino)propyl dihydrogen phosphorthioates and related compounds, including S-2-(ω-aminoalkylamino)ethyl hydrogen thiosulfates, were prepared and evaluated for radioprotective activity in mice. Intermediate N-(2-bromoethyl)-α,ω-alkanediamine dihydrobromides were prepared by the Cortese treatment of the 2-(ω-aminoalkylamino)ethanols. The requisite N-(3-bromopropyl)-α,ω-alkanediamine dihydrobromides were prepared from the 3-(ω-aminoalkylamino)-1-propanols and from the 3-(ω-phthalimidoalkyl)tetrahydro-1,3-oxazin-2-ones in two steps involving selective cleavage of the tetrahydrooxazinone ring. Intermediates obtained by the addition of 2-methyl- and 2,2-dimethylaziridine to acrylonitrile led to several branched-chain analogs. Aziridine-ring opening by ammonium thiosulfate was employed in the preparation of the inner Bunte salts monohydrochlorides. The phosphorothioates, as a series of a novel type, exhibited an exceptionally high level of radioprotective activity, whereas the thiosulfates were essentially nonprotective. Screening the compounds for activity was done in mice given lethal doses of x rays (825 R) or γ rays (950 to 1050 R). Five of the new compounds provided 100% 30-day survival of the mice as compared with 0% in controls. The LD_{50} doses of the compounds are tabulated. (BBB)

Radiation Sickness and Injuries

Refer also to abstracts 50572, 50589, 50870, and 50878.

50641 (JPRS-44044) TRANSPLANTATION OF HEMATOPOIETIC TISSUES IN RADIATION INJURIES. Sukhanov, M. P. Translated from pp 3-5; 19-36; 86-8; 205-9; 225-6 of Peresadka Krovetvornykh Tkaei Pri Luchevykh Porazheniyakh, Meditsina Press, Leningrad, 1967. 38p. CFSTI.

The two chapters discuss the storage and preservation of hematopoietic elements and the use of homologous bone marrow for treatment of radiation injuries in therapy patients. Topics discussed in the first chapter include: use of low temperatures and liquid media for preserving hematopoietic cells; effects of storage on functional properties of bone marrow cells; development of degenerative changes in suspensions of hematopoietic elements stored at low temperatures; preservation of bone marrow from fetuses; survival rate of bone marrow cells from rabbits; percentage of reticulocytes in suspensions of bone marrow stored at low temperatures; effects of freezing on bone marrow; effects of transplants of frozen bone marrow on irradiated dogs; effects of freezing bone marrow in the presence of monosaccharides and alcohols on survival rate of irradiated mice; and storage of bone marrow in glycerin at low and at room temperature. A separate abstract was prepared for the second of the two chapters translated. (H.L.W.)

For an abstract of the individual paper see: 50642.

50642 (JPRS-44044, pp 28-30) THERAPEUTIC EFFECT OF BONE MARROW ELEMENTS UPON TRANSPLANTATION IN PEOPLE INJURED BY IONIZING RADIATION. Translated from pp 86-8 of Peresadka Krovetvornykh Tkaei Pri Luchevykh Porazheniyakh, Meditsina Press, Leningrad, 1963.

Symptomatic treatment of radiation injuries in man including transfusions of whole blood, or erythrocytic and leukocytic masses, antibiotics, gamma-globulin, vitamins, and diets proved to have very little effect. This became a basis for the application of homologous bone marrow transplantations. After the homotransplantations of bone marrow, the overall condition of the injured improved considerably, the granulocyte and reticulocyte content in the peripheral blood became higher, and later they recovered and hematopoiesis became normal. For several years after the homotransplantation of bone marrow, the overall state of these persons has remained satisfactory. (auth)

50643 EFFECT OF INOSINE ON RADIATION DAMAGE, ESPECIALLY ON LEUKOPENIA. Moriyama, Tetsuro; Takaki, Hidetoshi; Mizukami, Tadahisa; Aoki, Takayuki; Noguchi, Shikazo; Furukawa, Mitsuhiko; Fukui, Kazusuke (Kurume Univ., Japan). Igaku Kenkyu, 36: 698-702(Dec. 1966). (In Japanese).

Attempts made to treat the radiation damage, especially leukopenia, occurring in the course of the radiotherapy for malignant tumors, are discussed. After administration of inosine, changes in peripheral counts of leukocytes in patients treated with ^{60}Co teletherapy were studied. At the start of ^{60}Co teletherapy six tablets of inosine were given to the patient daily and the number of his white blood cells was observed. These examinations revealed increasing white blood cell counts at the start of therapy, and at its termination, out of 20 cases, three showed an excellent response, 10 a good effect, six a fairly good effect, and one no effect of the drug. Leukocyte counts in cases in which the administration of inosine was delayed until after occurrence of leukopenia also showed a good response. Comparison between the cases treated with inosine and those not treated with it revealed that the increase in white blood cell counts was much higher in treated subjects, indicating that inosine is an effective radioprotectant, especially against radioinduced leukopenia. (BBB)

50644 TREATMENT OF LESIONS OF THE ORAL CAVITY AND JAWS IN PATIENTS WITH RADIATION INJURIES. Bobrowski, Antoni; Jastrzebski, Slawomir (Klinika Chirurgii Stomatologicznej, Warsaw). Czas. Stomatol., 19: 975-8(Sept. 1966). (In Polish).

Oral injuries that may occur as a result of accidents due to improper handling of radioactive isotopes, or during other uses of nuclear energy, are reviewed. The patients may be divided into 4 groups. Group I consists of those who receive total radiation doses above 600 R and survive no longer than two hr to two weeks. Group II includes those who received less than 600 R. In group III are those who, in addition to radiation injury, received injuries of mechanical, thermal, or chemical origin. Group IV consists of those who, in addition to radiation and various other injuries, also underwent internal contamination with radioactive dust resulting from exploding shells and fragments. The postirradiation clinical symptoms are divided into 6 stages: Stage 1, doses above 3000 R are followed immediately by acute reaction effects in the central nervous system, resulting in convulsions and death; Stage 2 after doses 2000 to 3000 R, fatigue, nausea, vomiting, and diarrhea are seen; Stage 3, doses of 800 to 2000 R may result in anorexia, fatigue, severe diarrhea, thirst, fever, delirium, and leucopenia. Stage 4, after doses of 360 to 800 R, acute insufficiency of bone marrow is noted, with ulceration of the alimentary duct and loss of hair (antibiotics are recommended here); Stage 5, doses of 250 to 350 R may lead to subacute insufficiency of bone marrow, lung and brain infections, large intestine functional impairment, and emaciation; Stage 6, doses up to 250 R lead to emaciation, chronic

anemia, premature aging, leukemia, and tumor development. The dental treatment of patients developing lesions of the oral cavity and jaw should be coordinated with a treatment provided by a physician. A dentist should remove all fillings and crowns irritating oral mucosa and gums, as well as bridges and other metallic prostheses. All teeth with gangrenous pulp should be extracted and the oral cavity should be rinsed with boric acid or potassium permanganate. Surgical treatment of the oral cavity and jaws should be completed if necessary. A physician should provide, if necessary, transfusions of blood, platelets, and white cells, antihistaminics, and drugs reducing oxygen consumption. Marrow transplants and drugs stimulating marrow function should be available. Hormones and vitamins, calcium derivatives, and a wide range of antibiotics may also be required. Patients should be served an easily digestible diet containing liver. Treatment of other physical injuries should then be completed. (BBB)

50645 USE OF THE PERISTALSIS MODERATOR REASEC FOR THERAPY OF DIARRHEA AFTER X IRRADIATION OR TREATMENT WITH RADIOACTIVE ISOTOPES. Miotti, R. (Kantonsspital, St. Gallen, Switzerland). Schweiz. Med. Wochensch., 98: 761-3 (May 18, 1968). (In German).

Results of treatment of 66 instances of diarrhea with Reasec, a meperidine derivative, in 52 patients irradiated with doses of 4000 to 5000 R of ^{60}Co for treatment of urogenital malignant tumors are reported. In 61 of the cases the results were good or very good after a dosage of up to 3 tablets/day. Each tablet contained 2.5 mg of Reasec (diphenoxylate hydrochloride) and 0.025 mg of atropine sulfate. Cases that did not respond to this amount gave favorable results at increased dosages. The patients tolerated the drug treatment well, and no toxic side effects were observed. The criteria of the severity of post irradiation diarrhea and the therapeutic response to the Reasec treatment are defined. (BBB)

50646 RESULTS OF INTERVENTION IN OCCUPATIONAL RADIODERMATITIS OF THE FINGERS. Lagrot, F. (Faculte de Medecine, Toulouse). Ann. Chir. Plast., Sem. Hop., 12: 157-60(June 1967). (In French).

Results are reported on 74 papers with radiation lesions of the fingers treated by surgical graft-incision techniques during an 18-yr period. A two-stage surgical technique was developed that gave good results for most cases. Half of the lesions treated were degenerate, and three recurrences appeared within one year following the excision. (C.H.)

50647 EFFECTS OF HEMOTHERAPY ON THE HEMORRHAGIC SYNDROME IN ACUTE RADIATION SICKNESS IN DOGS. Chaulytka, A. A.; Kryzhanouski, U. L. (Minsk Medical Inst.). Vestsi Akad. Navuk BSSR, Ser. Biyal. Navuk, No. 2, 75-80(1969). (In Belorussian).

In experiments on 132 dogs, manifesting hemorrhagic syndrome in acute radiation sickness, following a single x irradiation at a dose of 600 R, it was found that hemotherapy in combination with antibiotics and vitamins administered at the end of the latent period, according to the technique of V. V. Babuka and A. A. Cevlytko, prevented further development of the hemorrhagic syndrome. (auth)

50648 CYSTITIS CAUSED BY RADIOTHERAPY. Vizkelety, Gyula. Orv. Hetil., 109: 147-8(Jan. 21, 1968). (In Hungarian).

Radiotherapy is used to an increasing extent for the treatment of the malignancies of the womb. The bladder is exposed to x radiation primarily after surgical intervention. Weeks or months after gynecological operations, lesions have been noted in the bladder; they cause discomfort, frequent urination, and pain. Catheterization often further aggravates the situation, resulting in infection of the mucous membrane. After hyperemia and bullous edema ulceration may be encountered. Bleeding is difficult to control during the second stage which may start in one or two years and the broad-spectrum antibiotics are often not effective against bacterial infection. The only treatment during the period of sterile inflammation should be aimed only at the reduction of pain and discomfort; local treatment should be avoided if the urine is sterile. However, bacterial inflammation must be treated by chemotherapy and antibiotics. (TTT)

50649 THERAPEUTIC EXPERIENCE USING METALOC AGAINST RADIATION INJURY. Yamashita, Hisao; Yamada, Masahiro (Keio Univ., Japan). Shin'yaku To Rinsho, 17: 1623-6(Dec. 1968). (In Japanese).

In the radiation therapy of malignant tumors, it is necessary to suppress decrease of leukocytes. Metaloc was applied as a protective against this type of damage. Metaloc consists of Fe-, Cu-, and Co-chlorophyllin. A dose of 6 Metaloc tablets a day for each of 22 cases under radiation therapy changed the rate of decrease of leukocytes from 30% to 20%, excluding a few cases that had unusually high and low leukocyte numbers before therapy. These results show that Metaloc can be used as a recovery agent in cases of radiation therapy. (NSA of Japan) (TSS)

Radiodiagnosis

Refer also to abstracts 50109, 50110, 50132–50137, 50148, 50159, 50160, 50208, 50245, 50247, 50248, 50251, 50296, 50330, 50479, 50488, 50515, 50522, 50527, 50540–50542, 50551, 50557, and 50897.

50650 (BNWL-1051(Pt.2), pp 213-20) PRECISION WHOLE BODY COUNTING OF ^{59}Fe IN HUMANS. Palmer, H. E.; Cook, J.; Pailthorp, K. G. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Whole-body counting results and those from water phantom experiments showed that the total-body content of ^{59}Fe can be determined in a person of any size within an error of ±2%. Small people and the smaller sections of the body were brought to a constant size by adding Delrin plastic pellets. This constant thickness of scattering material provided constant Compton scatter count that was quite independent of the distribution. The accuracy of this counter for total-body ^{59}Fe measurement has made possible many studies that were previously impractical to do. (E.R.B.)

50651 ISOTOPIC DIAGNOSIS OF BONE INVOLVEMENT IN GYNECOLOGICAL CANCER PATIENTS. Kolar, J.; Bek, V.; Janko, L.; Vyhnanek, L.; Babicky, A. (Charles Univ., Prague). Zentralbl. Gynaekol., 90: 625-9(May 4, 1968). (In German).

The advantages of ^{85}Sr for detection of bone metastases in gynecological tumors were studied. The major advantages of ^{85}Sr over ^{47}Ca for bone scanning were its half life of 65 days and its comparatively low cost. When doses of 40 to 50 μCi of ^{85}Sr were given, the whole-body irradiation dose administered was estimated to be at most 2 R. For more complete scintigraphic studies of the skeleton with a γ camera, 100 μCi doses were required and the whole-body irradiation dose was higher. A study of the bony portions of the four limbs, the spine, and the pelvic bones could be completed in less than ½ hr, because measurement at selected points required only 10-sec counts. Uptake of ^{85}Sr in metastases was slower than in normal bone, so that a second scan was required after 7 days to identify these areas. Increased deposition of ^{85}Sr was found in metastases, spondyloses, arthroses, Paget's disease, and fibrotic bone dysplasias, but the exact nature of the bone defects could not be ascertained from the ^{85}Sr scans alone. (BBB)

50652 DETECTION OF BRAIN TUMORS USING RADIOISOTOPES. Oldendorf, William H. (Wadsworth Veterans Administration Hospital, Los Angeles). Bull. Los Angeles Neurol. Soc., 32: 220-33(1967).

Theoretical and practical aspects of brain scanning using radioisotopes are examined, and studies conducted with ^{99m}Tc to detect brain tumors are reported. Because γ rays of low energy are absorbed by skull and those of high energy are difficult to record and localize, energies between about 0.075 and 0.2 MeV are considered ideal for mapping the human brain. With this agent 10 mCi can be administered with much less patient irradiation than 0.5 to 1.0 mCi of ^{131}I-serum albumin or ^{203}Hg-chlormerodrin, the most common previous scanning agents. However, ^{123}I technology is advancing rapidly and, having radiation characteristics similar to ^{99m}Tc, this isotope may be more useful since iodine is much more readily incorporated into many compounds. The body handles ^{99m}Tc much like iodine and large concentrations appear in the parotid gland and nasal mucosa and, to a lesser degree, in the choroid plexus. In addition to the halo about the cranial cavity, the temporalis and occipital muscles pick up the isotope largely obscuring the posterior fossa. The overlying muscles and small brain preclude the useful external brain scanning of most experimental animals. Below the floor of the cranial cavity, much isotope is present. For this reason, tumors near the floor are often difficult to assess. Lesions within the cerebral hemispheres and particularly parasagittal lesions are most clearly defined. To obtain as many counts as possible in a short time a large dose of isotope may be required. The size of this dose will be limited by cost and the amount of patient irradiation allowable. Patient irradiation can be reduced if the isotope decays very rapidly or is removed quickly from the body. It is also desirable if the isotope does not produce β particles in addition to γ rays since the β particles will irradiate tissue but not contribute to the external count. These criteria are best fulfilled by ^{99m}Tc, which has a half-life of 6 hr, a γ energy of 0.14 MeV, and does not produce a β particle. It is inexpensively produced from a cow containing resin-bound ^{99}Mo. (BBB)

50653 ISOTOPIC EXPLORATION OF THE THYROID IN CLINICAL MEDICINE. Perez, R. (Hopital Americain, Neuilly-sur-Seine, France). Ann. Biol. Clin. (Paris), 26: 525-66(May-June 1968). (In French).

The place of ^{125}I, ^{131}I, and ^{132}I in investigations of thyroid function can be understood by considering the various steps in iodine metabolism. The overall measurement of cervical radioactivity, commonly called the thyroid uptake curve, is the usual clinical measurement. The principles of the method and the results obtained are discussed. The combination of this method with the chemical estimation of the plasma protein bound iodine and measurement of the achilles tendon response gives in most cases adequate information for the diagnosis of common conditions of the thyroid. Thyroid scanning is the usual ancillary method of investigating the morphology of the gland. Thyroid scanning has constituted an important advance in the knowledge of thyroid nodules and ectopic thyroid tissue. When routine methods of isotopic investigation encounter particular difficulties in interpretation, caused essentially by variations of the intra and extrathyroid iodine pools or hormonal disturbances, special isotopic techniques may be necessary to investigate particular steps in the metabolic iodine pathway. These methods are reviewed. (auth)

50654 APPLICATION OF THE MATHEMATICAL THEORY OF SEQUENTIAL SAMPLING TO GAMMA SCANNING IN NUCLEAR MEDICINE. Katzenstein, Henry S. (Solid State Radiations, Inc., Los Angeles); Kleinrock, Leonard; Stubberud, Allen; Friedland, Stephen S. Contract AT(04-3)-627. Math. Biosci., 4: 499-530(May 1969).

The time for performing a γ scan in nuclear medicine may be reduced by optimum use of the statistical data from the scan to control the time of observation at any given point. In the work described, the sequential sampling technique was applied to the problem of proportioning observation time on the basis of observed counts. In the limit of both very high and very low count rates, advantage is taken of the rapid decision time afforded by the good statistics of high rates and the a priori rejection of areas exhibiting low rates. Areas of intermediate activity require longer times to obtain a statistically significant estimate of activity. In this scanning method, accumulated counts from a stationary sensor are compared with two (linearly) time-varying thresholds: upon crossing either threshold an intensity estimate is made (which may be binary) and the scan continued to the next point. This procedure is well known in sequential hypothesis testing and the theory developed is pertinent to the γ scanning application. An analysis of the system as compared to a fixed observation-time-in-scanning was made. For a two-level detection system, with a given error probability and a given ratio of decay rate for a high-activity region to that for a low-activity region, it was found that the average observation time for a variable threshold scanning is approximately half that for fixed-time scanning. (auth)

50655 LYMPH NODE SCANNING WITH ^{99m}Tc–SULFUR COLLOID. Hauser, W.; Atkins, H. L.; Richards, P. (Brookhaven National Lab., Upton, N. Y.). Radiology, 92: 1369-71(May 1969).

Gelatin-stabilized technetium-99m-labeled sulfur colloid prepared by the H_2S method was the scanning agent for lymph nodes. The ideal physical properties of technetium-99m allow optimum collimation so that individual nodes can be clearly delineated. The study does not cause any patient discomfort, and no adverse reactions from the radiopharmaceutical were observed. (auth)

50656 DIFFERENTIATION OF MALIGNANT FROM BENIGN LESIONS OF THE THYROID GLAND USING COMPLEMENTARY SCANNING WITH ^{75}SELENOMETHIONINE AND RADIOIODIDE. Thomas, Colin G. Jr.; Pepper, Francis D.; Owen, Judith (Univ. of North Carolina, Chapel Hill). Ann. Surg., 170: 396-408(Sept. 1969).

From 89th Annual American Surgical Association, Cincinnati, Ohio. See CONF-690424.

Photoscans with radioiodine and ^{75}Selenomethionine were performed in 46 patients in whom thyroid carcinoma was suspect. The uptake of ^{75}Selenomethionine in the thyroid represented the rate of protein synthesis—reflecting mitotic activity and cellularity. The scans proved to be complementary in that a mass cold by radioiodide and hot with ^{75}Selenomethionine had approximately one chance out of two of being cancer. There were no false negative ^{75}Selenomethionine scans. Utilization of these scanning technics in conjunction with a careful appraisal of the clinical findings permits a more accurate preoperative diagnosis of thyroid cancer and helps eliminate unnecessary surgery for benign lesions of the thyroid. (auth)

50657 ADVANCES IN DYNAMIC RADIOACTIVE SCANNING. Wang, Yen (ed.). Springfield, Ill., Charles C Thomas Publisher, 1968. 134p. $8.50.

Separate abstracts were prepared for each of the nine chapters presented. (B.G.D.)

For abstracts of individual chapters see: 50132–50137 and 50658–50660.

50658 PROGRESS IN RADIOPHARMACEUTICAL DEVELOPMENT. Numerof, Paul (E. R. Squibb and Sons, New York). pp 81-100 of Advances in Dynamic Radioactive Scanning. Wang, Yen (ed.). Springfield, Ill., Charles C Thomas Publisher, 1968.

Progress in the field of radiopharmaceutical development in recent years is reviewed. The current rate of development of new radioisotopes, new pharmaceuticals, and more sophisticated instrumentation suggest no reason for expecting the rate of progress to slacken. (E.R.B.)

50659 RECENT DEVELOPMENTS IN PANCREATIC SCANNING. Sodee, D. Bruce (Doctors Hospital and Renner Clinic Foundation, Cleveland Heights, Ohio). pp 101-11 of Advances in Dynamic Radioactive Scanning. Wang, Yen (ed.). Springfield, Ill., Charles C Thomas Publisher, 1968.

The techniques involved in scanning of the pancreas utilizing the radiopharmaceutical Selenomethionine–^{75}Se are discussed. The results of animal studies in the investigation of the dosimetry of Selenomethionine–^{75}Se are presented. (auth)

50660 PARATHYROID SCANNING. DiGiulio, Walter (Veterans Administration Hospital, Ann Arbor, Mich.); Beierwaltes, William H. pp 112-26 of Advances in Dynamic Radioactive Scanning. Wang, Yen (ed.). Springfield, Ill., Charles C Thomas Publisher, 1968.

The problem of correctly localizing a hyperfunctioning parathyroid adenoma preoperatively is so important that any progress made in this area with the use of radionuclide-labeled compounds is important. The relative concentrations of $^{57}Co\ B_{12}$ are such that it shows little promise in differentiating parathyroid gland from thyroid gland, but theoretically it may some day prove to be considerably more effective than ^{75}Se-methionine in locating parathyroid adenomas in the mediastinum. Experience to date indicates that it is possible to correctly locate hyperfunctioning parathyroid adenomas greater than 1 gm but not when they are 1 gm or less. The relative tissue concentrations of ^{75}Se-methionine found in five humans make it possible to easily detect a phantom tumor of 2 cc in volume with a conventional 3-inch crystal photoscanner, and less definitely, a 1 cc volume tumor. The parathyroid concentration of ^{75}Se methionine can be increased in dogs by intracarotid artery infusion by a factor of ten times over that achieved by intravenous administration. The amino acid or amino-acid analogue that will concentrate in the parathyroid gland more avidly than ^{75}Se-methionine has not been found. (auth)

50661 INTRAVAGINAL MARKERS FOR ACCURATE RADIONUCLIDE LOCALIZATION OF THE PLACENTA. Rosenthall, Leonard (Montreal General Hospital). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 106: 787-90(Aug. 1969).

Fifteen pregnant patients were studied with regard to the accuracy of the symphysis pubis as an indirect indicator of the position of the internal cervical os in placental imaging. A radionuclide marker was placed in the posterior vaginal fornix to approximate the region of the internal cervical os. The distance between this marker and the one placed over the symphysis pubis ranged from 0 to 8 cm, with an average of 4 cm. It is concluded that an intravaginal, rather than a pubic, marker is required to distinguish placentas which are low-lying and previa, since the two conditions necessitate divergent management. This is particularly true of those patients wherein the fetus is in a transverse lie and the cervix is pulled cephalad. (auth)

50662 SCINTIGRAPHIC FINDINGS IN PULMONARY MICROEMBOLISM. Eaton, S. Boyd; James, A. Everette; Potsaid, Majic S.; Fleischner, Felix G. (Harvard Medical School, Boston. Massachusetts General Hospital, Boston). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 106: 778-86(Aug. 1969).

A two fold scintigraphic pattern consisting of decreased radioactivity along the interlobar fissure and apparent diminution in the size of involved lobes is presented for ^{131}I-albumin macroaggregate scans of patients with pulmonary embolism. The findings appear to result from multiple pulmonary microembolism, a disease entity which occurs commonly and which can produce a circumferential zone of pulmonary hypoperfusion. Reflex peripheral vasoconstriction and development of bronchopulmonary collaterals may augment this effect. (C.H.)

50663 PULMONARY PHOTOSCAN–ROENTGENOGRAPHIC COMPARISONS IN SARCOIDOSIS. Shibel, Elaine M.; Tisi, Gennaro M.; Moser, Kenneth M. (Georgetown Univ., Washington, D. C. Univ. of California, San Diego). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 106: 770-7(Aug. 1969).

The role of radioisotope scanning in the evaluation of 31 patients with pulmonary sarcoidosis was examined. Chest roentgenograms and scans in each patient were classified and compared. Poor correlation existed between roentgenographic and scan classifications.

Results of the studies indicate that the lung scan reflects the vascular component of pulmonary parenchymal involvement more accurately than the chest roentgenogram. Studies are underway to determine whether it correlates more closely with pulmonary function than the chest roentgenogram. (C.H.)

50664 RADIOISOTOPIC VERSUS ULTRASONIC TESTING FOR PULMONARY EMBOLISM. Collins, L.; Myhill, J. (Royal North Shore Hospital, Sydney. Univ. of Sydney). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 106: 766-9(Aug. 1969).

Radioisotope scanning for the diagnosis of pulmonary embolism has two main disadvantages: (1) the patient may be too ill to be moved to the scanning machine or too ill to keep still for the time required to perform a scanning; and (2) because of the limited spatial resolution of scanning techniques, the scan provides only broad information regarding the blood flow in the lungs. Thus there is a need for a small portable instrument which can quickly provide accurate information. Such a technique has been described by Miller et al. based on the use of ultrasound. The principle employed is analogous to radar, using sound rather than electromagnetic waves. Ultrasonic waves travel unchanged through a uniform medium. When, however, a change in acoustic impedance, i.e., a change in density or elasticity, is encountered, part of the energy of the wave is reflected and received at the transducer which doubles as transmitter and receiver. Ischemic areas of lung, produced by pulmonary emboli, have increased density over normal tissue, and this is probably the cause of the echoes characteristic of an abnormal lung. Thirty-one consecutive patients who were referred for radioisotope scanning for suspected pulmonary emboli were also examined by ultrasound. The end of one test and the beginning of the other were separated by less than five minutes. Thus the state of the lungs observed in each test was the same. The final diagnosis, based on all available clinical and laboratory evidence, was pulmonary embolism in 26 of the 31 patients. Radioisotope scanning gave no false positives and one false negative diagnosis in this small series. The ultrasonic test gave no false positives and four false negatives. In five cases the radioisotope scan and the ultrasonic scan were contradictory. The results are discussed in detail. (C.H.)

50665 LIVER AND SPLEEN SCINTISCANNING WITH ^{113}In. A CLINICAL PATHOLOGIC CORRELATION. Potchen, E. James; Adatepe, Mustafa (Washington Univ., St. Louis). Contract AT(11-1)-1653. Amer. J. Roentgenol., Radium Ther. Nucl. Med., 106: 739-44(Aug. 1969).

Three hundred and thirty-one consecutive patients had liver and spleen scanning performed with indium-113m. A pathologically correlated follow-up was obtained in 92 instances. The specific patterns recognized on the indium-113m liver scan were correlated with the disease entity, suggesting that the indium-113m agent is at least equivalent to previously available radionuclides for hepatic reticuloendothelial demonstration. In addition, minimal changes in preparatory techniques cause increased splenic accretion, affording a new and useful agent for routine spleen scanning. (auth)

50666 POSITIVE "BRAIN" SCANS IN FIBROUS DYSPLASIA AND OTHER LESIONS OF THE SKULL. Kieffer, Stephen A.; Loken, Merle K. (Univ. of Minnesota, Minneapolis). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 106: 731-8(Aug. 1969).

Positive brain scans were obtained in a number of benign and malignant lesions of the bony calvaria utilizing ^{99m}Tc as the scanning agent. The vascularity of these processes may account for the uptake of ^{99m}Tc. It is important therefore to always closely correlate the roentgenographic examination of the skull with the brain scan. (auth)

50667 SERIAL BRAIN SCANNING WITH ^{99m}Tc AND SCINTILLATION CAMERA. Handa, Jyoji; Nabeshima, Sachio; Handa, Hajime; Hamamoto, Ken; Kousaka, Tadako; Torizuka, Kanji (Kyoto Univ.). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 106: 708-23(Aug. 1969).

Serial brain scanning with gamma-ray scintillation camera and ^{99m}Tc pertechnetate was performed on patients with suspected brain lesions and the chronologic patterns of serial scintiphotographs were related to the pathology. Regressive accumulation of radioactivity of the focus was observed in arteriovenous anomalies, meningiomas, and angioma, whereas the gliomas, metastatic carcinomas, sarcomas, infarctions, and abscesses showed a progressive course of isotope uptake. In intracerebral hematomas and cystic tumors the focus remained persistently cold. Chronologic patterns of the uptake ratio were determined digitally and classified into 4 groups. It was concluded that the tumor vascularity plays an important role in determining the regressive course of uptake of ^{99m}Tc. Another mechanism of isotope uptake, presumably local breakdown or lack of barrier mechanisms, seems to be a factor also. (C.H.)

50668 PREPARATION AND TESTING OF A STERILE ^{113}Sn–^{113m}In GENERATOR. Colombetti, Lelio G.; Goodwin, David A.; Hinkley, Robert L. (Veterans Administration Hospital, Palo Alto, Calif.). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 106: 745-9(Aug. 1969).

A ^{113}Sn–^{113m}In generator, to produce sterile, pyrogen-free eluate, is described. The simplicity of preparation and operation of this generator providing sterile eluate is a great advantage in medical applications. This generator was tested and found sterile and pyrogen-free over a four month period, during which time it was in daily use for patient studies. (auth)

50669 USES OF DESK COMPUTERS IN NUCLEAR MEDICINE. Colombetti, Lelio G.; Horner, Richard W.; Kellner, James J. (Stanford Univ., Palo Alto, Calif.). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 106: 874-8(Aug. 1969).

Many tests performed daily in the nuclear medicine laboratory involve fitting a single exponential function to a number of observed data points in order to determine such parameters as decay constants, half times of disappearance, and activity at zero time. Since these curves are logarithmic, they are usually drawn by plotting the observed data on semilogarithmic graph paper and then fitting to the points what appears to be the best straight line. This procedure is subjective and may be misleading, especially when there is considerable scatter of the data points. This gives rise to the possibility that different individuals may draw significantly different lines through the points. As an alternative, the method of least squares, or regression analysis, which provides an objective method of determining the line of best fit, is suggested. If these calculations are done by hand, they are generally too time consuming for routine clinical procedures. The use of small programmable desk calculators (such as the Olivetti Programma 101) whose programs can be externally stored on magnetic cards were tested and found satisfactory for obtaining the results required in this type of work. (C.H.)

50670 TV SYSTEM FOR DATA BLENDING AND CONTRAST ENHANCEMENT OF SCINTISCANS. Hertsch, George J.; Melton, Mattie L.; Mooney, Richard T. (Francis Delafeld Hospital, New York). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 106: 871-3(Aug. 1969).

A TV system was developed that permits rapid data blending, contrast enhancement, and image reversal of the original scintiscan. The advantage of this TV system is that it allows the clinician to rapidly obtain the optimum image of the original scan by simple adjustment of controls. (C.H.)

50671 RESULTS OF LIVER SCANNING. Umek, H.; Czembirek, H. (Univ., Vienna). Deut. Med. Wochenschr., 94: 1574-6; 1577(Aug. 1, 1969). (In German).

In 120 patients, liver scanning was performed using ^{198}Au-colloid or ^{99m}Tc-labeled S colloids. In 21 cases of clinically and histologically proven cirrhosis of the liver there were diffuse foci of activity over the organ, with increased activity over spleen and bone marrow. In 35 patients with clinical and serological evidence of malignancy of the liver-scanning confirmed the diagnosis. The method is a valuable addition to the usual clinical tests and examinations. (auth)

50672 LUNG SCANNING WITH ^{113m}In-LABELLED Fe(OH)$_3$ AGGREGATES. Tori, G.; Cabassa, N.; Marabini, A.; Franchi, R. (Univ., Bologna. Ospedale Divile, Verona, Italy). Minerva Med., 60: 2793-2809(July 14, 1969). (In Italian).

Gamma camera lung scanning with ^{113m}In-labeled iron hydroxide aggregates offers a simple and rapid means for the study of both organic and functional changes in pulmonary blood flow. Experience using this method in about 100 patients with various diseases of the respiratory system is reported. Lung photoscanning has the advantage of allowing a number of projections to be made in a very short space of time even in seriously ill subjects. A new divergent-type collimator was used to give a considerable increase in the area scannable by the γ camera. Simultaneous visualization of both lungs was possible even in subjects of large build. Iron hydroxide macroaggregates labeled with ^{113m}In represent an important methodological advance in this field; they are readily prepared in the laboratory after elution of the ^{113}Sn–^{113m}In generator. High activity doses (1.5 to 2 mCi) can be used and the examination is thus speeded up. Lung uptake is about 0.75 rad per mCi. (auth)

50673 USES OF THE RADIOISOTOPE RENOGRAM WITH EMPHASIS ON EVALUATION OF URETEROPELVIC JUNCTION OBSTRUCTION. Santiago, Joseph A. (Naval Hospital, Philadelphia). J. Urol., 102: 347-52(Sept. 1969).

The radioisotope renogram using ^{131}I-hippuran is a useful diagnostic aid when used in conjunction with conclusions gathered from other examinations (i.e., excretory urograms and arterio-

grams). The renogram has a spectrum of applications, being particularly useful in confirmation of urinary tract obstruction, qualitative determination of renal function, determination of functional obstruction in ureteropelvic junction obstruction, postoperative followup of pelvioureteroplasties, estimation of obstruction or renal function in patients sensitive to contrast material, estimation of obstruction or renal function in pregnant patients and children, and confirmation of renal artery stenosis. (auth)

50674 ^{132}I IN NUCLEAR MEDICINE. II. PROPERTIES OF THE IODINE GENERATOR ^{132}I IMPORTED FROM THE GERMAN DEMOCRATIC REPUBLIC. Jirounek, P.; Raban, P.; Brousil, J. (Karlova Univ., Prague). Cesk. Radiol., 22: 322-7 (Sept. 1968). (In Czech).

The radiochemical purity of ^{132}I obtained from different supplies of iodine generators of East German manufacture was checked. Measurements of disintegration curves and γ spectra revealed that in some cases considerable contamination of ^{132}I by ^{132}Te, ^{131}Te, and ^{131}I is present. The monogram for calculation of specific activity provided by the firm was also checked and its validity range established. A method for checking new supplies of ^{132}I generators was recommended. (auth)

50675 BRAIN-SCANNING IN THE DIAGNOSIS OF METASTATIC BRAIN TUMORS. Stanbro, William W.; Murphy, Cornelius F. (George Washington Univ., Washington, D. C.). Med. Ann. D. C., 38: 135-6(Mar. 1969).

The results of brain-scanning with ^{99m}Tc-pertechnetate and ^{197}Hg-chlormerodrin were compared in 155 patients scanned with both isotopes. The dose of ^{99m}Tc used (5 mCi) when injected intravenously resulted in a maximum of 40,000 to 60,000 cpm. The dose of ^{197}Hg was 15 μCi/Kg, not exceeding a total dose of 1 mCi. This amount of activity injected intravenously resulted in a maximum of 2000 to 4000 cmp. Of 155 patients scanned with both ^{99m}Tc and ^{197}Hg there were 16 positive scans in patients suspected of having metastatic brain tumors. All 16 had a histologic diagnosis of malignant neoplasm. The ^{197}Hg scans were positive in all 16 patients. Both the ^{197}Hg and ^{99m}Tc scans were positive in eight patients, although in one the Tc scan demonstrated the lesion so poorly that no conclusion could have been reached without the backing of the ^{197}Hg scan. There were eight out of the 15 patients scanned with both isotopes in whom only the ^{197}Hg scans were positive. The explanation for the superiority of the ^{197}Hg scans with metastatic tumors is not known, although it may be associated with the tumor-brain concentration ratio. (BBB)

50676 PLACENTAL LOCALIZATION BY THE USE OF ^{132}I-HUMAN SERUM ALBUMIN AND BY ULTRASONIC SCANNING: A COMPARATIVE STUDY. Aiers, M.; Evered, D. C.; Smith, A. H. (General Infirmary, Leeds, Eng.). J. Obstet. Gynaecol. Brit. Commonwealth, 76: 220-4(Mar. 1969).

The safety, convenience, and accuracy of an isotope and ultrasonic technique for determining the site of the placenta were compared in 62 patients. Isotope placentography was performed using 40 μCi ^{132}I-human serum albumin, injected intravenously. Ultrasonic placentography was carried out using the technique of compound sector β scanning. Placental localization by ^{132}I-human serum albumin is established as a useful and safe technique. It was calculated that the radiation dose from 50 μCi ^{132}I-human serum albumin is 5 mrad to the fetal gonads and 130 mrad to the fetal thyroid. This compares favorably with a whole-body radiation dose of 1000 mrad to the fetus from conventional 2-plane soft-tissue radiography. The placental site was predicted with considerable accuracy by isotope placentography in 55 of 57 patients, follow-up information being unavailable for the remaining 5 patients. The placental site was forecast correctly by the ultrasonic technique in 49 out of 51 patients, or 49 out of 57 patients, when failures of localization were included. A difficulty with isotope placentography experienced twice in this series was the occurrence of high counts at the opposite pole to the placenta due to see-through. The magnitude of the see-through phenomenon would be considerably reduced, if not entirely eliminated, by the use of ^{99m}Tc-labeled serum albumin. The problem of see-through is inherent in the technique of placing the collimator of the scintillation detector perpendicular to the uterine wall, but nevertheless, the method should give a more anatomically correct localization of the placenta than a scan done in the horizontal place. In determining the most suitable method for placental localization, several factors must be considered, including the probability of locating the placenta, the accuracy with which it can be located, and the radiation dose to the patient. The ultrasonic method, in general, seems to be the preferable technique for placental localization. (BBB)

50677 TUMOR LOCALIZING AGENTS. VII. RADIOIODINATED QUINOLINE DERIVATIVES. Counsell, R. E.; Pocha, P.; Ranade, V. V.; Sterngold, J.; Beierwaltes, W. H. (Univ. of Michigan, Ann Arbor). J. Med. Chem., 12: 232-6(Mar. 1969).

Attempts to develop a radioiodinated analog of chloroquine as an agent that would selectively localize in melanomas are reported. Results with radiolabeled melanin precursors were discouraging, but preliminary studies with radiolabeled melanin-seeking compounds were most promising. Chloroquine was selected as the model compound for distribution studies in normal and melanotic mice because ^{14}C-chloroquine is commercially available and the synthesis of a stable radioiodinated analog was considered readily accomplished. 4-Chloro-7-iodoquinoline was used for the preparation of the desired iodo analogs for chloroquine. From this key intermediate it was possible to obtain a number of 4-substituted 7-iodoquinolines for radiolabeling experiments and subsequent tissue distribution studies. Introduction of radioiodine by isotope exchange with ^{125}I or ^{131}I posed a problem because of the relative instability of the compounds under the conditions required for exchange. This was avoided by use of appropriate solvents. One compound, 4-(3-dimethylaminopropylamino)-7-iodoquinoline-^{125}I, that was synthesized was found to have a marked affinity for melanin-containing tissues and for melanotic tumors in animals. The concentration of radioactivity in tissues of melanotic mice following administration of 10 μCi is shown. While at 1 day many tissues showed considerable radioactivity, only tumor, eye, skin, adrenal, and thyroid contained appreciable radioactivity after 4 days. (BBB)

50678 MODERN METHODS IN NUCLEAR MEDICINE. Adam, W. E.; Lorenz, H. J. (Univ., Ulm, Ger.). Med. Klin. (Munich), 63: 401-8(Mar. 15, 1968). (In German).

Various applications and new methods for use of radioisotopes in clinical diagnosis were discussed briefly. These included studies of organ morphology with stationary detectors, such as the autofluoroscope and γ camera, advances in conventional functional diagnosis based on use of semiconductor detectors, short-lived radionuclides, positron emitters, and radioimmunological assays. Methods for neutron activation analysis were described briefly. These procedures included the preparation of the sample to be analyzed, introduction of the sample and standard probes into the reactor, removal and processing of the activated probes, and measurement of the γ spectra of the radionuclides induced in the samples. Analytical methods for the inactive tracer technique of neutron activation analysis were compared with in vivo activation analysis procedures. Applications of computer techniques in nuclear medicine were indicated briefly. (BBB)

50679 PLACENTAL SCANNING. Thoms, George; Papworth, Michael (Cancer Inst., Melbourne). Med. J. Aust., 2: 640-1 (Oct. 12, 1968).

In a discussion of the hazards of placental scanning it is pointed out that such scanning is a clinically proven technique in which the radiation risk is acceptable compared with the diagnostic value of the investigation. The radiation dose from a soft-tissue radiograph of the abdomen, the routine radiodiagnostic procedure for placental localization, is about 1000 mR. There is no evidence that controlled soft-tissue radiography has induced any abnormalities. The technique whereby ^{99m}Tc-albumin was used for placental scanning in 150 cases was more accurate than soft-tissue radiography. There was no selective uptake of ^{99m}Tc in any organ, so that the radiation doses involved (25 to 35 mR) were much less than the environmental radiation level (about 100 mR per annum). For these reasons, placental localization with radioisotopes is the method of choice. (BBB)

50680 RADIOCHEMICAL PURITY OF SHORT-LIVED ^{99m}Tc FROM COMMERCIAL SUPPLIERS. Crosby, E. H. (Guthrie Clinic, Sayre, Pa.). Radiology, 92: 166-7(Jan. 1969).

Small laboratories whose work loads do not justify purchasing ^{99}Mo-^{99m}Tc generators on a routine basis find it convenient and not unreasonably expensive to order the separated ^{99m}Tc when required. There are three major radiopharmaceutical houses which supply ^{99m}Tc as sterile sodium pertechnetate, ready to use for brain scans. During the summer of 1968 a series of radiochemical purity determinations was carried out on routine shipments from all three suppliers. The levels of impurities observed were well within the specifications laid down by the Atomic Energy Commission, but the major type of impurity consistently observed in shipments from two of the suppliers has apparently not been reported in the literature to date. All three suppliers use neutron-irradiated molybdenum rather than the older fission product material. The technetium-99m from one of the suppliers showed less than 3×10^{-4}% ^{99}Mo with no other detectable long-lived contaminants. From the other two suppliers, however, the pattern observed was consistently different. The dominant long-lived impurity observed in over 15 shipments was ninety-hour rhenium-186, usually at levels between 0.01% and 0.001% of the technetium-99m activity at time of elution. The highest ^{186}Re level observed was 0.05 per cent, still within the 0.1% maximum specified by the A.E.C. Molybdenum-99 was not detected in any of these samples. Because ^{186}Re

has its main gamma radiation at 137 keV, it is completely overlooked in the usual type of measurement for ^{99}Mo contamination. When an aliquot of eluant from a ^{99}Mo–^{99m}Tc generator was placed inside lead shielding to cut out the 140 keV radiation from ^{99m}Tc in order to calibrate the 740 to 780 keV radiation from ^{99}Mo against the 662 keV radiation from a ^{137}Cs standard, the 137 keV radiation from ^{186}Re was naturally cut out also. If the generator systems sold by the major suppliers have the same chemistry as the generators they use for their own production, then methods of assay for radiochemical purity should be re-examined by all users, whether they buy generators or separated technetium-99m. (auth)

50681 IMAGE-INTENSIFIER FLUOROGRAPHY IN PEDIATRIC RADIOLOGY: SEVENTY-MM. FLUOROGRAPHY AS A DIAGNOSTIC AID. Kaude, Juerl V.; Slusher, Donald H. (Univ. Florida Coll. of Medicine, Gainesville). Clin. Pediat. (Philadelphia), 8: 106-9(Feb. 1969).

A new pediatric radiologic technique that reduces patient radiation exposure is presented as well as dosimetric data obtained in children. Fluoroscopic procedures in x-ray examination of children were facilitated by the use of an image intensifier and television (video-fluoroscopy). This technique has many advantages over conventional direct fluoroscopy or image-intensifier fluoroscopy with mirror viewing, such as possibility of selecting the contrast and magnification on the television monitor and the viewing distance to the monitor. The examination can be completed in shorter time with lower radiation doses to the patient. Photographing the image on the output screen of the image intensifier with a 70-mm spot film camera (70-mm fluorography) simplified the spot filming and further reduced irradiation of the patient. A Philips 6-in image intensifier with television output and a 70-mm camera with arrangements for rapid sequence operation (up to six films/sec) were used. The films in pediatric examinations were usually made at 3 to 8 mA-sec and 65 to 90 KV. In examinations of adults the integral absorbed dose from 70-mm fluorography was about 12 to 30% of that required for full-scale radiography. Measurements of gonad doses from voiding urethrocystography in children were made. Substituting 70-mm fluorography reduced the gonad dose to about 13% in boys and 48% in girls over that required for full-scale serial radiography. (BBB)

50682 ISOTOPE DIAGNOSIS IN BONE AND JOINT DISEASES. Kolar, J.; Babicky, A.; Janko, L.; Bek, V.; Vyhnanek, L.; Streda, A. (Charles Univ., Prague). Med. Klin. (Munich), 62: 1738-42 (Nov. 10, 1967). (In German).

Results of ^{85}Sr studies in 344 patients with bone and joint diseases are reported. Administration of a 100-μCi dose resulted in a whole-body dose of about 1.5 to 4.6 R, but usually the dose of ^{85}Sr given to adults was 40 to 50 μCi, and for children the amount of ^{85}Sr given was only 15 to 20 μCi. Because of the nonhomogeneous distribution of ^{85}Sr in the skeleton, the average irradiation dose in areas of increased deposition was higher than the average value. Measurements of ^{85}Sr bone deposition were made up to three weeks after administration in some bone diseases, although the activity remaining for measurement was considerably decreased by that time. Generally, the ^{85}Sr distribution was measured 24 hr, and sometimes seven days, after administration. When the entire skeleton was scanned, the dose of ^{85}Sr required was 100 μCi, and measurements were made for 10 to 20 sec at each part of the skeleton that was studied. It was not possible to compare numbers of counts from patient to patient because of their wide variability, but counts in the extremities of the same patient did not vary much. The activity of the spine and the limbs were compared with the average value of the tibia. The normal ratio for the spine was from 1.8 to 2.8. Higher values were taken as indication of pathological bone disease. (BBB)

50683 PLACENTAL LOCALIZATION: A COMPARISON BETWEEN ULTRASONIC COMPOUND B SCANNING AND RADIOISOTOPE SCANNING. Kohorn, E. I.; Walker, R. H. Secker; Morrison, J.; Campbell, S. (Univ. Coll. Hospital, London). Amer. J. Obstet. Gynecol., 103: 868-76(Mar. 15, 1969).

Radiation hazards associated with localization of the placenta are considered in a comparative study using ^{99m}Tc-HSA (human serum albumin) and ultrasonic scanning. Modern radioisotope scanning procedures give accurate information about the placental site with a radiation dose of only 5 mrad. In the use of ^{131}I-labeled HSA the radiation dose received by the mother and the fetus is only a small fraction of that received during radiography. The introduction of ^{132}I and ^{51}Cr-labeled erythrocytes reduced the radiation dose still further. The use of ^{99m}Tc-HSA made automatic scintillation scanning possible, and this technique is probably more reliable than previous radioisotope methods. In the present study, scintillation scanning was started 5 min after the intravenous injection of ^{99m}Tc-HSA, 4 μCi/Kg body weight (200 to 350 μCi). Both this method and ultrasonic scanning gave accurate localization of the placenta, and there was agreement between them in 46 patients. Ultrasound scanning was superior to radioisotope scanning, as it visualized the fetus, and by the use of the full bladder technique, it permitted determination of the precise relation of the placenta to the internal os of the uterus, a method independent of surface landmarks. Although the dose of irradiation with ^{99m}Tc-HSA scanning is very small, there is no radiation or other hazard with ultrasound. However, the ultrasonogram requires more experience in interpretation than the radioisotope scan. It is suggested that ultrasound placentography is the best method for a large obstetric unit, while radioisotope scanning is more suitable for a small obstetric unit in a general hospital. (BBB)

50684 NEUTRON ACTIVATION ANALYSIS OF TRACE METALS IN TISSUES. Frischauf, H. (Univ., Vienna). Radiol. Aust., 18: 103-6(1968). (In German).

In an elementary form, activation analysis is discussed with respect to general principles and applicability for the determination of trace elements in biological material. Briefly mentioned are results of experimental studies with thermal neutrons. Noted is a decrease in copper and manganese content of leucocytes in leukemia, especially in the chronic myelotic form; however, a trace metal pattern characteristic for malignant tumors was not established. (H.B.G.)

50685 COMPUTER-FOCUSING FOR AREA SCANS. Nagai, T.; Iinuma, T. A.; Koda, S. (National Inst. of Radiological Sciences, Chiba, Japan). J. Nucl. Med., 9: 507-16(Oct. 1968).

A method was developed for iterative approximation with a digital computer to approach the true isotope distribution in area scanning. This computer-focusing technique offers a means of decreasing the blur in area-scan images introduced by lack of resolution of the collimator and of providing more accurate information. (auth)

50686 LOCALIZATION OF SCINTILLATIONS IN GAMMA-RAY CAMERAS BY TIME-OF-FLIGHT TECHNICS: LINEAR RESOLUTIONS ATTAINABLE IN LONG FLUORESCENT RODS. Marinelli, L. D.; Clemente, G. F.; Abu-Shumays, I. K.; Steingraber, O. J. (Argonne National Lab., Ill.). Radiology, 92: 167(Jan. 1969).

In gamma-ray cameras, consisting of adjacent prismatic rods, tangible advantages would ensue if sufficiently accurate localization of scintillations resulted from timing the delay between pulses arising in photomultipliers attached at the ends of each rod. In plastic scintillators (refraction index ≈1.5) distances of about 1 cm correspond to intervals of 0.1 ns, whenever axially directed photons are operative. Precision in this type of measurement performed with small fluors is about ±0.1 ns. It is affected by statistical characteristics of: scintillation emission; photoelectron conversion; and circuit inertia. Obviously, resolutions of practical use (~1 inch) should be possible over areas of 10^4 cm^2 and more, if the use of long rods does not magnify these uncertainties unduly, owing to inevitable variations in the path lengths traveled by the light protons. The importance of this factor was investigated experimentally in scintillating rods of various brands and dimensions irradiated by collimated ^{137}Cs and ^{60}Co sources. Results led to the conclusion that the superiority of bialkali photocathodes is substantial, and the speed of existing constant-fraction trigger circuits is adequate; pilot Y (more transparent, but slower) is inferior to Pilot B; the liquid scintillator P4G12 is faster and merits serious consideration; the increase in dispersion with rod length (≈1 cm ft^{-1} in Pilot Y) is a rather insensitive inverse function of energy; improvement of resolution with decreasing rod diameter is small; the time interval vs. distance plot is linear throughout a 60 cm Pilot B rod; total specular reflection improves spatial resolution by increasing this slope to 142 ps cm^{-1}, irrespective of pulse height, leaving time resolution virtually unchanged; temporal and spatial resolution are practically independent of scintillation site in the faster scintillators; and triggering pulse-height fraction considerably affects time resolution, but leaves spatial resolution practically unchanged. These results, in view of collimation analysis published elsewhere, justify construction of an instrumental model for the localization of very low gamma activity in vivo. (auth)

50687 SKELETAL SURVEY FOR METASTATIC TUMORS OF BONE USING ^{18}F AND ^{85}Sr WITH SCINTILLATION CAMERA AND WHOLE-BODY SCANNER. Ronai, Peter; Winchell, H. S.; Anger, H. O. (Univ. of California, Berkeley. Highland Alameda Hospital, Oakland, Calif.). J. Nucl. Med., 9: 517-22 (Oct. 1968).

A rapid radioisotopic skeletal survey is feasible using ^{18}F, the whole-body scanner and the positron scintillation camera. A larger number of bone lesions can be detected with ^{18}F than with either conventional skeletal x ray surveys or ^{85}Sr radioisotopic skeletal surveys. Fluorine-18 is taken up by both malignant and nonmalignant lesions of bone and the ^{18}F skeletal survey primarily serves

to indicate areas for careful radiological assessment and, if necessary, biopsy. Since ^{85}Sr radioisotopic skeletal surveys have previously demonstrated the capability of detecting metastatic bone lesions in the absence of radiologic changes, and since the present study strongly suggests the superiority of ^{18}F over ^{85}Sr in this regard, it is proposed that ^{18}F skeletal survey using a whole-body scanner and positron camera is the most efficient means yet developed for detection of metastatic bone disease. (auth)

50688 CRITICAL EVALUATION OF RENAL NUCLEAR DIAGNOSTIC METHODS IN PEDIATRICS. Hoer, G. (Univ., Munich). Arch. Kinderheilk., 176: 263-80(Jan. 1968). (In German).

The application of ^{131}I and ^{99m}Tc for renal diagnosis in pediatric patients was reviewed and discussed. Reports indicated that ^{131}I may be secreted in human milk. However, the use of ^{131}I-hippuran was shown to result in minimal irradiation risk, because according to dosimetry data, the irradiation burden for whole-body, blood, kidney, and gonads was less than 3 mR/10 μCi. In children under 16 yr of age the thyroid dose exceeded 1.3 mR. For diagnostic tests in children it was concluded that precautions to prevent irradiation should include greater use of ^{99m}Tc, acceleration of ^{131}I excretion from kidney by use of diuretics, and blocking of the thyroid with KI, by means of which thyroid uptake of ^{131}I may be decreased to as low as 5%. (BBB)

50689 A NEW METHOD FOR QUANTITATIVE EVALUATION OF CEREBRAL BLOOD FLOW BY RHEOENCEPHALOGRAPHY. Hadjiev, D. (Research Inst. of Neurology and Psychiatry, Sofia). Brain Res., 8: 213-5(Apr. 1968).

A method employing ^{131}I was developed for measuring cerebral blood flow (CBF) by the venous dilution principle. Correction of recirculation was made. Mean arterial pressure was determined by a bloodless procedure after which the cerebral vascular resistance was estimated. Frontomastoid rheoencephalograms were registered with the 2-channel rheograph of Schuhfried. The anacrotic section of the curve was determined from its initial rising point up to its top, after which the relative part of the anacrotic section of the rheoencephalogram was calculated as a percentage of a single cardiac cycle. This parameter gives information regarding the cerebral vascular resistance of the investigated hemisphere. Correlation analysis was carried out of the cerebral vascular resistances as determined by the radioisotope venous dilution method and by the anacrotic section of the rheoencephalogram. The regression coefficient of both parameters was also established. Investigation of 20 patients with cerebral ischemic disturbances showed that the volume velocity of the cerebral blood flow of the affected hemisphere varied between 460 and 183 ml/min (average 292 ml/min), and the cerebral vascular resistance of the same hemisphere varied between 12.4 and 35.5 × 1332 dyne/sec/cm^{-5} (average 23.3 × 1332 dyne/sec/cm^{-5}). The relative part of the anacrotic section of the rheoencephalograms of the investigated patients varied between 0.095 and 0.260 (average 0.183). (BBB)

50690 MEDICAL IMAGE QUALITY REQUIRED RELATIVE TO RADIATION INJURY. Stieve, F. E. (Univ., Munich). Roentgen Bl., 20: 545-66(Dec. 1967). (In German).

Factors that influence the resolution and general quality of radiograms are discussed and described in detail. These include relative illumination required for various types of films, resolution characteristics of television fluoroscopy as functions of the dose level at the image intensifier input, uses of plexiglas phantoms for study of detail perception, detail perceptibility for conventional fluoroscopy, television fluoroscopy with dose outputs of 10 to 80 μR/sec at the image intensifier input screen, and target films, each as a function of contrast and detail size, experimental set-up for measurement of automatically regulated dose output behind the objective and at the input of an image intensifier, experimental set-up for measurement of incident and output doses in television equipment for various phantom thicknesses, incident dose output for various objective thicknesses of from 7.5 to 30 cm of water related to the dose output at the input of an image intensifier with automatic brightness stabilization, principles of automatic brightness stabilization in an image intensifier-television system, dose output of a 30 KW tube for currents of from 0.5 to 3 mA, relations between voltage regulation, dose output, and objective thickness; incident dose outputs in thoracic, gastric, and gall bladder fluoroscopy; alteration of contrast with voltage and dispersion; and alteration of contrast and dose output as a function of body thickness. (BBB)

50691 PLACENTAL LOCALIZATION BY ISOTOPE AND ULTRASOUND SCANNING. Walker, R. H. Secker; Kohorn, E. I.; Morrison, J. (University Coll. Hospital, London). Proc. Roy. Soc. Med., 62: 446-8(May 1969).

Scanning with ^{99m}Tc-albumin and ultrasound was compared for efficiency in locating the placenta in 75 patients, the two methods being performed the same day whenever possible. There was agreement in 68 patients (90%), apart from minor differences as to whether the placenta lay more to the right or to the left of the mid-line. In three patients the radioisotope scan suggested a minor degree of placenta previa while the ultrasound scan did not, and in two patients the reverse occurred. None of these patients was actually found to have a placenta previa. One other patient had a major degree of placenta previa correctly diagnosed by ultrasound, but two radioisotope scans gave conflicting results. Both methods failed to diagnose a Stage II posterior placenta previa scanned at 26 weeks. On one occasion the placenta was not located by ultrasound, but was clearly demonstrated by the radioisotope scan. These results suggest that ultrasonic compound B scanning is slightly superior to the ^{99m}Tc technique. The radioisotope scans show the placental blood pool and an outline of the uterine wall. However, the cervical region is not visualized with certainty, and the fetus is never seen. In this method, both the mother and fetus receive a small dose of irradiation (about 5 mrad) but even this is best avoided in pregnancy. The ultrasound technique offers two important advantages over the radioisotope method: there is no radiation hazard; the relations of the placenta, the presenting part, and the lower uterine segment can be demonstrated. (BBB)

50692 MEDICAL APPLICATIONS OF RADIONUCLIDE INSTRUMENTATION TECHNIQUES. PART TWO. RADIOIODINE FOR TESTS OF THYROID FUNCTION. Barnaby, C. F.; Edmonds, C. J. (University Coll. Hospital Medical School, London). World Med. Electron., 5: 332-7(Dec. 1967).

Fundamental aspects of the use of radioiodine in studying thyroid physiology and pathology are reviewed, including physical properties of all known radioisotopes of iodine, advantages and disadvantages of use of the various isotopes, decay schemes of ^{131}I and ^{132}I, design of collimeters and detectors, and other aspects of instrumentation for thyroid scanning. Correction for absorption when β counters are used for ^{131}I counting is explained. The use of ^{132}I in certain thyroid tests and the data needed for interpreting results are outlined. Iodine-125, with its very low γ energy, is generally only used where measurements are to be made on samples of tissue or fluids removed from the body. Iodine-128 has been suggested for diagnostic use by hospitals close to reactors, but its use is not normally practicable. Use of gamma cameras is discussed, as well as the introduction of ^{99m}Tc scanning to replace radioiodine. Technetium-99m has considerable possibilities in scanning since it emits low-energy γ rays only, 90% of which are of 140-keV energy. Technetium is handled by the thyroid like iodide but is not organically bound so that the uptake is relatively small, usually about 1% of the dose given. Thus to obtain a reasonable satisfactory scan about 1 mCi, as pertechnate, must be administered but the actual radiation dose to the thyroid is relatively small. (BBB)

50693 ATTEMPT TO ESTIMATE THE SPLEEN WEIGHTS FROM THE RADIOISOTOPE SCANS. Ueda, Hideo; Chiba, Kazuo (Tokyo Univ.). Kaku Igaku, 5: No. 2, 146-51(July 1968). (In Japanese).

The study was based on the eight operated spleens of idiopathic portal hypertension. Scintiscanning was performed by ^{203}Hg-MHP-method before splenectomy. The cross-sectional areas of the spleen taken by the scan were measured by planimeter. After the spleen was removed by operation, blood of the spleen was completely washed out by perfusion of saline. The spleen was weighed after the saline was removed. The spleen weights thus obtained were plotted against the scan surface areas of the corresponding spleen on the log-log paper. A linear relationship was found to exist between these values. The spleen weights were also plotted against the volumes calculated from an equation on the section paper and the curve indicated a straight line relationship. This is good correlation between the estimated spleen weights derived from the equation and the operated weights. Estimation of spleen weight is necessary for the calculation of the total splenic blood flow based on the radioactive rare gas clearance method that is one of the important indexes to determine the indication of splenectomy in portal hypertension. (auth) (TSS)

50694 ANTISCATTER GRIDS FOR LOW-ENERGY NEUTRON RADIOGRAPHY. Parks, Paul B.; Brown, Mark (E. I. du Pont de Nemours and Co., Aiken, S. C.). Radiology, 92: 178-9(Jan. 1969).

Background fogging from scattered neutrons is an inherent problem in neutron radiography of hydrogenous substances such as biological tissue. Antiscatter grids are described that were developed for thermal and epithermal neutron radiography. The design follows the standard technics used in roentgenography except for the choice of materials. Since aluminum is radiolucent to low-energy neutrons, it was employed to separate the neutron opaque planes that define the small acceptance solid angle. Cadmium and indium

are the neutron opaque materials used for the thermal and epithermal grids, respectively. The efficacy of the thermal neutron grid was established by comparison of thermal neutron arteriograms of a rat's thigh, paw, and tail taken with and without the grid. The artificially contrasted arteries were undiscernible in the thicker portion unless the antiscatter grid was used. (C.H.)

50695 DETERMINATION OF EFFECTIVE AND TOTAL CORONARY BLOOD FLOW USING ^{84}Rb. Leb, G.; Derntl, F.; Goldschlager, N.; Cowan, C.; Bing, R. J. (Wayne State Univ., Detroit). Amer. J. Med. Sci., 257: 203-17(Apr. 1969).

Theoretical and practical aspects of coronary blood flow determination by use of ^{84}Rb are dealt with. The positron emitter, ^{84}Rb, and a double coincidence counting system for external measurement of myocardial ^{84}Rb uptake were first introduced by Bing et al. Effective capillary flow and total coronary blood flow to the myocardium were studied in closed-chest anesthetized dogs using a coincidence counting system and a bolus injection of ^{84}Rb. Effective capillary flow was calculated as the relation of myocardial uptake of ^{84}Rb, counted externally, to the integrated arterial concentration curve, obtained by continuous counting of arterial radioactivity in a well counter and extrapolating the downslope of the first circulation. Total coronary blood flow was determined from the Fick principle by dividing the integrated difference of arterial and coronary sinus ^{84}Rb concentration into the myocardial uptake. The results indicate that changes in total coronary flow and effective capillary flow after administration of pharmacologic agents are directional but not parallel. (BBB)

50696 STATISTICAL MODEL FOR THE VISUALISATION OF CHANGES IN THE COUNT DENSITY ON RADIOISOTOPE SCANNING DISPLAYS. Mallard, J. R.; Corfield, J. R. (Univ. of Aberdeen, Scotland). Brit. J. Radiol., 42: 530-8(July 1969).

A simple descriptive model of the mental processes involved in the visualization of count density variations in radioisotope scanning displays is proposed in which an area of interest is compared with the regions around it. From this a new approach is developed by which the visual significance of an area is related to the statistical significance of the area from its surroundings. This leads to the determination of the statistically optimum sampling area for a Gaussian profiled image. Application of the method explains some experimental work on the visual perception of noise limited images under practical scanning conditions. (auth)

50697 NUCLEAR MEDICINE: HEPATIC, BLOOD POOL, AND RENAL NUCLEAR MEDICINE PROCEDURES. Usher, Michael S. (Wesley Memorial Hospital, Chicago). J. Kans. Med. Soc., 69: 361-6(Aug. 1968).

Use of ^{99m}Tc-sulfur colloid, ^{198}Au colloid, and ^{131}I-Rose Bengal for liver scanning; ^{99m}Tc- and ^{131}I-albumin and ^{113m}In for blood pool scanning (e.g., placenta); and ^{197}Hg- and ^{203}Hg-chlormerodrin for renal scanning is reviewed. Emphasis is placed on use of the Anger camera and isotopes such as ^{99m}Tc and ^{113m}In that are short lived, give lower patient doses, and provide higher photon yields. Illustrative cases of their use are cited. (BBB)

50698 ACCURACY OF RADIONUCLIDE LOCALIZATION OF THE PLACENTA. Werch, Angel; Burdine, John A. Jr. (Baylor Univ., Houston, Tex.). Amer. J. Obstet. Gynecol., 103: 354-7 (Feb. 1, 1969).

The use of ^{131}I-serum albumin (RISA), ^{113m}In, and ^{99m}Tc to detect abnormal implantation of the placenta was evaluated for accuracy and compared for safety to radiographic and other placenta localization methods. Measurements were made of radioactivity levels in maternal and fetal blood and in the newborn's thyroid gland. After administration of 5 μCi RISA, point counting was accomplished by plotting the distribution of 2-min counts in a grid containing 12 sectors overlying the gravid uterus and pelvis. The procedure was begun 5 min after injection of RISA. Excellent results were obtained in 88.7% of 60 with scanning, and 82.7% with point counting. The use of short-lived isotopes such as ^{113m}In and ^{99m}Tc adds even greater potential to the test. The extremely small dose of RISA-^{131}I used (5 μCi) subjects the fetus to minimal radiation exposure, averaging $^1/_{10}$ of that received by the fetus with a single abdominal radiograph. The bound isotope remains almost entirely within the maternal circulation, being slowly eliminated through the kidneys at a rate of 5% daily; ~2% of the total activity is eventually excreted in the feces. To confirm the absence of significant radioactivity from the fetal circulation, the authors examined cord blood at delivery and blood from the newborn 30 min after birth for the presence of radioactivity above background. In 10 patients included in this survey, cord blood counts were slightly higher than background, but they were not considered statistically significant. No infant was found to have significant thyroid radioactivity following birth. (BBB)

50699 RADIOZINC UPTAKE BY THE ACUTELY DAMAGED PANCREAS OF RATS. Makara, G. B.; Papp, M.; Csaki, L.; Pal, I. (Inst. of Experimental Medicine, Budapest). Acta Med. Acad. Sci. Hung., 23: 389-93(1967).

The possibility of using radiozinc to detect pathology in various abdominal organs was investigated in rats with pancreatic injury. The uptake of ^{65}Zn (given as glycinate or gluconate) by the pancrease, liver, and jejunum was studied. In intact animals, the curves for ^{65}Zn uptake by the pancreas ran a high and almost continuous course from the first to the 7th hour after injection. In laparotomized animals, the pancreas took up much less, the liver more, and the jejunum about as much of the injected ^{65}Zn as it did in intact rats. In animals with deoxycholate-induced pancreatitis, ^{65}Zn uptake by the pancreas was slight even in relation to that in laparotomized rats. Uptake by the jejunum was also decreased and that by the liver remained unchanged. The decrease in ^{65}Zn uptake was probably caused by decreased blood flow through the inflamed pancreas. (BBB)

50700 SPINAL FLUID APPEARANCE OF ^{99m}TECHNETIUM PERTECHNETATE. Janeway, Richard (Bowman Gray School of Medicine, Winston-Salem, N. C.); Maynard, C. Douglas; Witcofski, Richard L.; Lax, Louis C. Arch. Neurol., 19: 618-22(Dec. 1968).

Technetium-99m pertechnetate, widely used as an agent for brain scanning, has nearly ideal γ-emission energy (140 keV), short half-life (6 hr), and absence of primary particle radiation, so that relatively large doses can be used with good definition and resolution. At the same time, the radiation dose is reduced when compared to other brain scanning agents. Little information is available to explain why certain lesions are associated with abnormal accumulations of radioactivity while others do not show this uptake. To determine whether alterations in permeability might possibly account for some of this variation, the fractional rate was observed at which an intravenously injected dose of ^{99m}Tc-pertechnetate appeared in the cerebrospinal fluid (CSF) of neurologically normal patients. Data for the fraction of injected dose/g of plasma and CSF were plotted in semi-logarithmic form along with a computer-fitted function. Results showed that the biological half-life of ^{99m}Tc-pertechnetate in CSF is twice as long as the corresponding phase for blood plasma. The range of normal in this composite study is relatively narrow, and there is evidence that the use of estimates of CSF concentration of ^{99m}Tc may improve the diagnostic accuracy of brain scanning techniques. (BBB)

50701 CLINICAL APPLICATIONS OF SHORT-LIVED CYCLOTRON-PRODUCED ISOTOPES. Arnot, R. N.; Glass, H. I.; Williams, E. D. (Hammersmith Hospital, London). J. Physiol. (London), 200: 17p(May 1969).

An advantage of short-lived isotopes used in diagnosis is the small radiation dose that is associated with their administration to patients. This small radiation dose allows radioisotopes to be used in specialties such as pediatrics and obstetrics, that previously were areas of restricted application of radioactivity. The use of short-lived isotopes in double-isotope studies using a combination of a short-lived and long-lived tracers has also introduced new possibilities. Using this double-isotope technique in association with a dual detector quantitative scanner, new methods of assessing the blood volume of the spleen and the rate of destruction of red cells in the spleen were developed. Some of the applications of short-lived isotopes described included placental localization, measurement of cerebral blood flow in premature babies, measurement of blood volume in athletes, measurement of splenic blood volume, and measurement of splenic function. (BBB)

50702 STUDIES ON DYNAMICS OF HEPATIC ^{65}Zn UPTAKE AND ITS CLINICAL APPLICATION. Nishi, Tsuneo (Osaka Univ.). Osaka Kaigaku Igaku Zasshi, 20: 327-34(Sept. 1968). (In Japanese).

Rats with experimental chronic hepatic disturbance from carbon tetrachloride and thioacetamide were given ^{65}Zn to investigate the ^{65}Zn uptake capacity of the liver. It was discovered that the ^{65}Zn uptake capacity of animals with chronic hepatic disturbance is remarkably decreased compared with normal animals. External measurement of the canine liver with hepatic circulatory disturbance was done immediately after the administration of ^{65}Zn to compute the coefficient of hepatic ^{65}Zn uptake from the multi-compartment analysis of the hepatic ^{65}Zn uptake curve. This coefficient was found to show markedly lower values in dogs with portal vein stenosis than in normal dogs. Applying the results obtained in the above-mentioned basic investigation clinically, the dynamics of hepatic ^{65}Zn uptake of patients with cirrhosis and chronic hepatitis were evaluated quantitatively and conveniently by external measurement. A close correlation was found between the coefficient of hepatic ^{65}Zn uptake and the log BSP value. The hepatic ^{65}Zn uptake coefficient was markedly lower in cases with chronic hepatitis than in normal cases and was still lower in cases with liver cirrhosis. The possibility of differentiating liver cirrhosis from chronic hepatitis utilizing this method was demonstrated. (NSA of Japan)

50703 THE USE OF RADIOFIBRINOGEN IN THE EVALUATION OF THE COLD AREAS OF THE HEPATIC SCANS. Riccioni, N.; Becchini, M. F.; Navalesi, R.; Lofaro, A. (Univ. of Pisa, Italy). J. Nucl. Biol. Med., 12: 101-6(July-Sept. 1968).

An external counting isotope method was developed to differentiate neoplastic from nonneoplastic lesions in the liver. The method is based on the study of the time course of the radioactivity, after injection of ^{131}I-fibrinogen (RIF), on the cold areas detected by a liver radiocolloid scan. Forty-one patients with scintigraphic patterns of a solitary defect or multiple local defects were examined with RIF. The results concern only the 21 cases in which the diagnosis could be established by liver biopsies, laparoscopy, surgery, or autopsy. RIF gave a positive result in eight of ten malignant lesions and only in one of eleven non-malignant lesions. The indications and possible improvement of the methodology are discussed. (auth)

50704 THE USE OF SULPHYDRYL CONTAINING DRUGS AND CHELATING AGENTS TO REDUCE RENAL IRRADIATION DURING ^{203}Hg CHLORMERODRIN SCINTIGRAPHY. Cardinale, A.; De Simone, G. F. (Univ. of Palermo, Italy). J. Nucl. Biol. Med., 12: 121-7(July-Sept. 1968).

Results of experiments on drugs capable of accelerating the renal excretion of radiomercury are reported. The testing drugs were sulphydryls containing substances and chelating agents. Among the sulphydryls containing substances BAL, β-mercaptoethylamine, cysteine and thioctic acid were found to accelerate the elimination of radiomercury. The results obtained by the use of chelating agents do not seem, at present, satisfactory. Sulphydryls containing drugs seem useful in diminishing the dose to the kidneys resulting from renal scanning with ^{203}Hg-chlormerodrin. (auth)

50705 RADIATION INJURY AND ROENTGEN EXAMINATIONS OF INFANTS AND CHILDREN, TOGETHER WITH A PROPOSAL FOR PROFESSIONAL TRAINING. Gefferth, K. (Medical Univ., Budapest). Acta Paediat. Acad. Sci. Hung., 8: 231-9(1967). (In German).

The general problem of late irradiation injuries observed after diagnostic x ray studies performed in normal practice, either too frequently or on particularly radiosensitive subjects, is discussed These included chronically sick patients and those that received excessive gonadal doses. The injuries included malignant tumors, fetal death, miscarriages, malformations, and reduced life expectancy. Frequent pelvic examinations of pregnant women resulted in malformations and deranged development of the offspring. Several factors that may produce chromosomal mutations and problems that affect proper training in radiology were discussed. (61 references.) (BBB)

50706 IN VITRO UPTAKE OF LABELLED AMINO ACIDS BY THE SKIN OF CHILDREN WITH GENERALIZED CONGENITAL ANALGESIA. Merzel, J.; Blumen, G.; Schmidt, B. J.; Maia, J. C.; Raw, I.; Castro, N. M. (Univ. Sao Paulo, Brazil). Nucl.-Med., 8: 83-8(Apr. 15, 1969).

The in vitro uptake of ^{14}C-labeled tyrosine, tryptophan, and leucine by the skin of two children with GCA (Generalized Congenital Analgesia) was compared with that in normal individuals. Through radioactivity counts and radioautographic procedures it was shown that the uptake of the two aromatic amino acids was reduced in the GCA individuals; the protein synthesis seemed to be normal. The possible relationship of these results to an abnormal metabolite isolated from the urine of these patients is discussed. (auth)

50707 CLINICAL APPLICATION OF RENAL SCANNING WITH A SHORT-LIVED NUCLIDE ^{113m}In. Imaeda, Takeyoshi; Senda, Kouhei; Nishioka, Kiyoharu; Shimada, Masahiro (Gifu Univ., Japan). Radioisotopes (Tokyo), 18: 258-63(July 1969). (In Japanese).

Renal scanning using ^{113m}InFe-compounds was found clinically useful. One to one and a half milli-curie of several ^{113m}InFe-compounds was injected into the vein of rats and the average concentration ratio (kidney-to-liver) of ^{113m}InFe-DTPA ascorbic acid obtained from five rats was 8.5 at thirty minutes after the injection. Because of this high concentration ratio, ^{113m}InFe-DTPA ascorbic acid is considered more suitable for renal scanning than other ^{113m}InFe-compounds. Eighty milli-grams of Probenecid were given to rats to block the renal filtration before injection of ^{113m}InFe-compounds. There was a remarkable difference following the administration of Probenecid, the kidney-to-liver ratio increased to 11.2 with rats. Clinically, there was also a noteworthy difference. The renal concentration at 30 min after the injection of 6 mCi of ^{113m}InFe-DTPA ascorbic acid to normal subjects increased by 12 to 45% by giving Probenecid to the subjects, the value being 100% at 4 min after injection. The similar increase with ^{113m}InFe-EDTA was 15%, from 41 to 56%. Patients are now given 500 mg of Probenecid per os 30 minutes prior to scanning in an attempt to block the renal filtration of ^{113m}InFe-compounds, and good scans are always obtained. (auth)

50708 DIAGNOSTIC X-RAY PROBLEMS IN YOUNG CHILDREN. Buttenberg, H. (Roentgenabteilung, Erfurt, Ger.). Z. Aerztl. Fortbild., 61: 15-17(Jan. 1, 1967). (In German).

The effects of relative body proportions during growth of infants and young children on precautions necessary to protect the gonads and other organs during diagnostic x irradiation are discussed. The use of various shields for the gonads, specialized equipment for positioning of children for thoracic or abdominal x-ray studies, use of fluoroscopic procedures with children, effects of physiological functions such as respiratory rate and pulse rate, use of filters, electronic image intensifiers, and x-ray television are reviewed briefly. (BBB)

50709 CORRELATION BETWEEN SOME ^{131}I TESTS OF THYROID FUNCTION. Gwiazdowski, B.; Makolska, J. (Inst. of Oncology, Warsaw). Post. Fiz. Med., No. 1, 29-39(1967).

On the basis of thyroid function examinations in 160 (mostly euthyroids) patients from the Institute of Oncology in Warsaw, various tests were compared with the 24-hour uptake. Rectilinear correlation was obtained between the 24-hour test and those of early uptake, urine excretion and conversion coefficient. No correlation was obtained with PBI^{131}. Some practical advantages of the correlated tests are discussed. (auth) (NSA of Poland)

50710 DETECTOR TECHNIQUES IN NUCLEAR MEDICINE. Kinzler, H. J.; Kirchmann, E. v. (Siemens Aktiengesellschaft, Erlangen, Ger.). Therapiewoche, 19: 1690-2(Sept. 1969). (In German).

Basic principles of gamma ray detection are reviewed. Several photographs represent equipment produced in Germany. Fields briefly covered are in vitro counting with well counters, portable detectors for blood volume determination, special instruments for thyroid uptake studies, movable single channel counters for rate measurements, two-channel analyzers with recorders for renal studies, and scanning equipment. (H.B.G.)

50711 DIAGNOSTIC VALUE OF RADIOISOTOPE SCANNING OF LIVER. Shahid, Maqbool Ahmad (Atomic Energy Medical Centre, Lahore). Nucleus (Lahore), 5: 65-9(July-Dec. 1968).

Experience in radioisotopes scanning of the liver has shown it to be an extremely useful procedure in the diagnosis of space-occupying lesions in the liver, and their exact localization. Information about the size, displacement, and function of the liver can also be obtained by this technique. Many cases who were labeled as pyrexia of uncertain origin and treated for weeks without any benefit were found on scanning to be suffering from liver abscess. It is therefore recommended that all cases of suspected liver affections should be subjected to liver scanning as a routine procedure wherever such facilities exist. Both ^{198}Au colloidal suspension and Rose Bengal labeled with ^{131}I were used but ^{198}Au gave better results than the other isotope. The higher dose of radiation received by liver from ^{198}Au can be minimized by using less amounts of this isotope with more sensitive scanning machines. Liver scanning also offers the facility of assessing the effect of treatment on the underlying disease by doing repeated studies. It also helps the physician in selecting the exact site where one should push the needle either for drainage or for taking the biopsy of the liver. (auth)

50712 RADIOFOSFORNAYA DIAGNOSTIKA V ONKOLOGII. (Phosphor Isotopes in Oncological Diagnosis). Dubovyi, E. D.; Leshchinskii, A. F. Kiev, Zdorov'ya, 1968. 216p.

Various aspects of oncological diagnostics using radioactive phosphors are reviewed. Pharmacological properties of ^{32}P and clinical data of the tracer doses on the organism are evaluated. Descriptions are given of the instruments used in diagnostics of tumors and of the differential diagnostics of malignant and inflammatory sicknesses. Extensive references are included. (R.V.ü.)

50713 RISKS ASSOCIATED WITH USE OF RADIOISOTOPES IN DIAGNOSIS. Wambersie, A. (Univ., Louvain, Belg.). Acta Chir. Belg., Suppl. 1, 19-29(1969). (In French).

Hazards inherent in radioisotope applications in clinical medicine are reviewed, with a presentation of actual doses received by patients in various tests as compared with maximum acceptable doses for the general population, genetic and somatic effects of radiation at low dose levels, and some recommendations for lowering the already very low risks. It is suggested that, even though it is admitted that all forms of ionizing radiation are potentially harmful, the doses used in clinical diagnosis are too low to constitute an appreciable hazard in the adult patient. The only restrictions in the use of such methods apply to young and pregnant pa-

tients, because of the increased sensitivity of developing and growing tissues. The risks of radiation sequelae in these patients must be balanced against the risk of incomplete clinical diagnosis of their medical state. The gonadal doses in radioisotope techniques are particularly low, with consequent small genetic hazards. Diagnostic examinations should be planned to obtain maximum information per dose unit of patient exposure. Dose reduction can be achieved best by use of highly sensitive detectors and by appropriate selection of an isotope that will give the shortest exposure possible. (BBB)

50714 SYSTEMATIC INVESTIGATIONS ON THE RELATIONS BETWEEN IN VIVO DE-IODINATION OF ^{131}I-ROSE BENGAL AND NUTRITIONAL INFLUENCE IN RATS. Bergner, H. (Humboldt-Univ., Berlin). Arch. Tierernaehr., 17: 51-68(Mar. 1967). (In German).

The in vivo deiodation of ^{131}I-Rose bengal in rats was investigated. The absolute level of deiodation was largely dependent on the production batch so that only parallel groups receiving the same ^{131}I-Rose bengal injections could be used for comparison. No significant differences in the level of deiodation were found by an investigation of several factors i.e., different strains of rats, the influence of sex, the influence of a 48-hour starvation period, or the administration of different amounts of fat. If protein diets were fed that are often known to produce a hypofunction of the thyroid gland (gelatine, cereal proteins, protein-deficient diets) the rate of deiodation was reduced. It may be concluded from this that a high thyroxine production is associated with a high rate of deiodation and, conversely, a reduced thyroxine synthesis results in a low deiodation. Hence, the ^{131}I-Rose bengal deiodation test may be regarded as a suitable measuring technique for estimating the thyroxine level in the organism. (tr-auth)

50715 EVALUATION OF GAMMA CAMERA SCINTIGRAMS USING MULTI-CANAL-STORAGE, COMPUTERS, AND COLOR TELEVISION SYSTEMS. Heiss, V.-D.; Prosenz, P.; Tschabitscher, H. (Univ., Vienna). Fortschr. Geb. Roentgenstr. Nuklearmed., 110: 108-17(Jan. 1969). (In German).

In the case of 12 patients the scintigrams obtained with the Anger gamma camera were processed with the aid of a 1600-channel store, an electronic data processor, and a color television system. Color television display of the scintigrams obtained by photographing the oscilloscope of the gamma camera with a Polaroid camera, ensures better clarity and demonstrability but does not enhance the information. Additional information can only be obtained by digital processing. The multi-channel store permits digital display of the scintigrams as a surface or in profile and is suitable for routine work owing to its simple application during the examination. Computer scintigraphy takes up considerable time and will only be used for special studies. (auth)

50716 RECENT ASPECTS OF CEREBRAL SCINTIGRAPHY. Planiol, Th.; Le Floch, O. (Hopital Bretonneux, Tours, France). Acta Chir. Belg., Suppl. 1, 54-76(1969). (In French).

New radioisotope techniques for diagnosis of brain diseases are surveyed, with emphasis on use of ^{99m}Tc (as pertechnetate or labeled albumin), ^{206}Bi (nitrate), ^{131}I (albumin), ^{197}Hg or ^{203}Hg (Neohydrin), and ^{113m}In (diethyltriaminepentaacetic acid chelate). Advantages and disadvantages of each are outlined. The physical characteristics of ^{99m}Tc make it particularly useful for cranial scintigraphy: its single γ emission of optimal energy for extracranial detection, short half life and lack of β emission that permit use of millicurie doses, and ready availability to the clinical lab. Irradiation received by the patient is reduced with this isotope; however, it is not concentrated selectively or markedly by cerebral tumors. A comparison is given of counts of meningiomas, glioblastomas, and metastases with ^{131}I, ^{197}Hg, ^{203}Hg, and ^{99m}Tc. (BBB)

50717 DETERMINATION OF PLACENTAL LOCATION WITH ^{99m}Tc. Townsend, Duane E.; Swanson, Leonard A. (Los Angeles County Harbor General Hospital, Torrance, Calif.). Amer. J. Obstet. Gynecol., 104: 560-3(June 15, 1969).

Localization of the placenta by photo and color dot scanning, with ^{99m}Tc-albumin, was performed on 50 patients. This technique was found to be as accurate as other radioisotope methods. Patients were first given a blocking dose of iodine to minimize the uptake of this isotope by the maternal and fetal thyroid gland. Thirty min later, 500 to 900 μCi of ^{99m}Tc-albumin was injected intravenously. Scanning was begun ten min after injection and was completed about one hr later. Excretion of unbound isotope into the urinary bladder caused some confusion in interpreting the scans. However, in 17 cases of possible placenta previa the placenta was demonstrated in 16 cases. The only failure was in a patient with a succenturiate lobe placenta previa. This technique was found to be highly accurate during the second and early portion of the third trimester. However, because of the short half-life and unavailability of ^{99m}Tc-albumin, this technique has limited application and currently is restricted to cases in which the radioiodine-albumin placentogram is unsatisfactory. (BBB)

50718 CONTRIBUTION OF RADIOISOTOPE TECHNIQUES TO RENAL SURGERY AND TO THE PROBLEM OF RENAL TRANSPLANTATION. Merchie, G. (Hopital de Baviere, Liege); Cleempoel, H.; Schoutens, A. Acta Chir. Belg., Suppl. 1, 123-54 (1969). (In French).

Hazards of irradiation are considered in the use of radioisotopes in renal surgery. In general, the risks of exploration of the kidney with radioisotopes are negligible and considerably lower than with radiography. The radiation dose received by one kidney varies considerably with the isotope used. For example, with 100 μCi ^{203}Hg-Neohydrin the renal dose is 5 to 50 rad, but is only $^1/_{10}$ as great with ^{197}Hg. It is still lower with ^{131}I-Hippuran, 30 μCi giving a renal exposure of only 30 mrad. This is about $^1/_{10}$ the maximum permissible daily dose for occupationally exposed persons. A $^1/_5$ reduction of this dose is possible by use of ^{125}I-Hippuran. Intravenous urography employing five x-ray photographs results in a dose of about 970 mrad, which is 30 times greater than that received in isotope studies of the kidney. (BBB)

50719 THE MEAN CLEARANCE OF COLLOIDAL RADIO-GOLD FOR EVALUATION OF THE HEPATIC CIRCULATION IN CHRONIC INFLAMMATORY DISEASES OF THE LIVER. Marculesco, Lidja; Jovin, G.; Hoanca, O.; Gheorghesco, B. (Gastroenterology Center, Bucharest). Rev. Roum. Med. Interne, 5: 231-43(1968). (In French).

A method for determining the removal of ^{198}Au from the blood during its passage through the liver is presented and a mathematical model was developed for relating the kinetics of ^{198}Au uptake by the liver that is useful in evaluating pathologic states in the liver. Tests were conducted in which 200 to 250 μCi of ^{198}Au in an average particle size of 3000 Å was injected intravenously. External counters were used to follow the activity over the liver for a 60-min period. The activity-time curve showed two components: a phase of rapid increase of activity, followed by a level, horizontal phase. A three-compartment model was devised, including blood, liver, and extrahepatic reticuloendothelial (RE) tissue. A clearance coefficient, K, was obtained, as representing the sum of ^{198}Au transfer from blood, based on its circulating volume. Under normal conditions the removal of ^{198}Au by the liver is greater than by other RE elements. The relative clearance by these two compartments is a measure of the condition of the liver, especially of the hepatic circulation. Results of studies in 39 patients with chronic hapatitis and cirrhosis are reported. (BBB)

50720 RADIOLOGICAL TRAINING AS A FACTOR IN RADIATION BURDEN. Henck, Friedrich (Zentral-Roentgeninstitut, Stuttgart). Strahlenschutz Forsch. Prax., 7: 49-60(1967). (In German).

Relations between degree of training in radiology and average irradiation doses administered to patients were reviewed and discussed briefly. It was found that the physicians with less radiological training tended to administer the greatest irradiation exposures to patients. The factors that were considered to be required to improve radiological treatment so that radiation exposure of patients would be decreased included adequate follow-up studies after irradiation by surgery or resection, continuous advanced training with experts in all fields of clinical medicine, and especially x-ray demonstrations, and continuous advancement in technical areas that would help to develop procedures to reduce radiation exposure. (BBB)

50721 ^{113m}In-GELATIN COMPLEX FOR PLACENTAL LOCALIZATION. Burdine, John A. Jr.; Werch, Angel (Baylor Univ., Houston, Tex.). Amer. J. Obstet. Gynecol., 104: 748-51 (July 1, 1969).

A newly introduced short-lived radioisotope was evaluated for use in placental visualization. This radioisotope, obtained through the use of a generator, permitted greatly increased doses in placental localization studies because of reduced radiation exposure. The isotope ^{113m}In has a half-life of 1.7 hr with no primary β-particle emission. When injected intravenously, rapid binding to a serum protein fraction (transferrin) occurs, and the compound circulates with a biologic half-life of about 3 hr. The use of this material was tested in 50 pregnant females. Carrier-free ^{113m}In was obtained by eluting a tin–indium generator with 0.05N HCl. The radiopharmaceutical for imaging blood pools was produced as follows: To 5 to 6 ml ^{113m}In generator eluate is added with stirring 1.0 ml 20% USP gelatin and 60 mg NaCl in 0.5 ml H_2O. It is titrated to pH 3.5 with 0.5N NaOH and autoclaved. The patient doses employed ranged from 1.0 to 1.5 mCi. The interval from injection to imaging averaged 15 min, although satisfactory results could be obtained with a delay of two hr or more. Because of the rapid decay of the isotope, a high-speed scanning or imaging device is

advantageous. The procedure required 12 to 15 min for an anterior view with maximum count rates of 50,000 to 80,000 cpm. Radiation exposure from the doses employed resulted in a calculated fetal dose of 15 to 25 mrad. Determination of the material dose fraction which passes through the placenta into the fetal circulation is critical for these calculations. This aspect was examined immediately following delivery by total-body counting of newborns in comparison with a standard phantom. In 7 patients, less than 0.3% of the injected dose was transferred to the child. In comparison, a single abdominal x-ray produces 500 to 1000 mrad and a 5-μCi dose of ^{131}I-human serum albumin results in an estimated exposure of 70 mrad. Compared with ^{99m}Tc-albumin, the ^{113m}In-gelatin complex is preferred because it is easier to prepare and does not collect to a significant degree in the urinary bladder. Free pertechnetate in the albumin preparation may reach a bladder concentration which effectively obscures the precise definition of the lower placental margin and its relation to the cervix. (BBB)

50722 INFLUENCE OF ABSORPTION OF PASTEURIZED COWS' MILK ON THE VALUE OF KUPFFER CELL UPTAKE OF ^{198}Au. Charbonnier, A.; Perrin, J.; Lahellec, M. (Centre Hospitalier Cochin, Paris). Presse Med., 76: 1882(Oct. 19, 1968). (In French).

The effect of drinking a glass of milk on the extraction of ^{198}Au from the blood by the liver was studied in 45 subjects, 25 normal and 20 cirrhotic. Two determinations of ^{198}Au uptake of liver Kupffer cells were made, at intervals of four to seven days. Immediately, before the second test the subject drank 160 to 180 ml of milk, each subject serving as his own control. A 100-μCi dose of ^{198}Au was given intravenously, and the liver uptake of radioactivity was followed continuously. The level of incorporation by the Kupffer cells was calculated from the classical formula: $A = A_{max}(1 - e^{-kt})$, where the coefficient k is calculated from the ratio of the value of the tangent at the actual origin of the curve and that of the maximum radioactivity at equilibrium. The origin is the exact point at which the uptake by the liver begins. This origin follows a vascular phase, seen immediately after injection of the isotope. The mean values of k before and after drinking milk were 0.334 and 0.411 in healthy subjects, and 0.267 and 0.442 in cirrhotics (general average 0.304 before and 0.424 after). The differences between before and after values are statistically significant for the cirrhotic group and for the totaled two groups. It is concluded that milk stimulates the phagocytic activity of the Kupffer cells for ^{198}Au. (BBB)

50723 DIAGNOSTIC APPLICATIONS OF RADIOISOTOPE SCANNING PROCEDURES. Simpson, R. Keith (Coll. of Osteopathic Medicine and Surgery, Des Moines, Iowa). J. Amer. Osteopath. Ass., 67: 756-66(Mar. 1968).

Brain scanning results with ^{99m}Tc are compared to those using ^{32}P, ^{42}K, ^{131}I-albumin, ^{206}Bi, and ^{197}Hg and ^{203}Hg compounds; and use of these and other isotopes in liver and kidney scanning is also dealt with. The advantages in using ^{99m}Tc are: short physical half-life, no initial β emissions, an optimum single γ emission of 140 keV, minimal radiation dose to patient, larger dose of isotope possible, greater statistical accuracy due to higher counting rates, and improved diagnostic information derived from scan. Consequently, millicurie amounts of ^{99m}Tc can be administered safely to the patient to give high count rates for photoscanning. The ^{99m}Tc is used as the pertechnetate ion (TcO_4) for thyroid and brain scanning, as a label for albumin for visualization of vascular structure and localization of the placenta, or in the colloidal form for liver and bone marrow scanning. The pertechnetate ion behaves like the iodide ion in certain respects, although it is trapped only temporarily within the thyroid and is not incorporated into thyroid hormones. Absorption is generally complete by the fasting subject, and the initial concentration is high in the thyroid, salivary glands, and the stomach. One to 5% of the dose enters the thyroid in the first 2 hr and is released a few hours later. In the first 24 hr 25 to 30% is excreted in the urine. Thereafter, the major excretion is in the feces. Liver scanning can be accomplished with several agents including ^{131}I-Rose Bengal, colloidal ^{198}Au, ^{65}Zn, ^{64}Cu, ^{99m}Tc, and ^{131}I-albumin. Relative advantages and disadvantages of each are outlined. (BBB)

50724 PULMONARY SCINTIGRAPHY OF VENTILATION AND INHALATION. PROPOSAL FOR A NEW TECHNIQUE FOR SCINTIGRAPHIC EXAMINATION OF THE LUNGS. Casamassima, F.; Pasqualucci, V.; Palumbo, R. (Univ., Perugia, Italy). Nunt. Radiol., 34: 421-34(May 1968). (In Italian).

A new technique for pulmonary scintigraphy is presented and proposed. This technique, which utilizes a half-open system at environment pressure values, presents the advantage of easy performance and conditions that take into account the respiratory physiology. (auth)

50725 CLINICAL SCINTILLATION SCANNING. Freeman, Leonard M.; Johnson, Philip M. (eds.). New York, Harper and Row, Publishers, 1969. 574p.

Separate abstracts were prepared on 17 chapters that discuss various aspects of radioisotope scanning. (C.H.)

For abstracts of individual chapters see: 50159, 50160, and 50726–50740.

50726 RADIOPHARMACEUTICALS. McAfee, John G.; Subramanian, Gopal (State Univ. of New York, Syracuse). pp 50-94 of Clinical Scintillation Scanning. Freeman, Leonard M.; Johnson, Philip M. (eds.). New York, Harper and Row, Publishers, 1969.

Radioactive agents effective for imaging applications must possess special physical, chemical, and pharmacologic characteristics which are different from those of nonradioactive drugs. Furthermore, there is a finite number of gamma-emitting radionuclides which have the essential physical properties to serve as the radioactive label. Thus far, the number of agents actually used for imaging applications in man has been small, and their mechanisms of localization in various body organs have been relatively simple. To achieve successful visualization of many smaller organs of the body which are not now amenable to morphologic study by any method, it is likely that more complex and specific biochemical mechanisms of active transport will have to be used. Unfortunately, the addition of labeling atoms to molecular structures often spoils their biochemical specificity and therefore their ability to concentrate in specific tissues and organs. Certain proteins and peptides, including enzymes, organ-specific antibodies, and tumor-specific antibodies, prepared from animal tissues exhibit remarkable specificity. These may prove successful agents for imaging if the difficulties in their purification and problems of antigenicity for man can be overcome. Before a physician uses a given radioactive agent for patient studies, he must have knowledge not only of the physical characteristics of the radionuclide but also of its radiopharmaceutical properties, organ distribution and excretion, and resultant radiation dose levels. There is an increasing trend to use short-lived gamma-emitting radionuclides and rapid methods of labeling to overcome statistical limitations encountered with imaging devices, resulting in improved resolution and reduction in radiation dosage to the patient. Moreover, with several devices now available, sequential images are possible, permitting a study of dynamic changes in concentration in an organ with time, in addition to static structure. Greater use should be made of the radionuclides of the transition metals for these applications, since many of them possess the desired physical characteristics. As a rule, they are promptly excreted from the body without prolonged retention in the viscera or skeleton. They have multiple valence states which exhibit different chemical and biologic behavior and may be coordinated with many compounds. (90 references.) (auth)

50727 RADIATION SAFETY FOR PATIENT AND PERSONNEL. Schulz, Robert J. (Albert Einstein Coll. of Medicine, New York). pp 95-115 of Clinical Scintillation Scanning. Freeman, Leonard M.; Johnson, Philip M. (eds.). New York, Harper and Row, Publishers, 1969.

Procedures for the protection of both patients and personnel during the preparation and use of radioisotopes for scanning are reviewed. It is pointed out that the radiation dose to the patient will vary with the nuclide, chemical compound, method of administration, and metabolism by the patient. The combined β and γ dose to the liver following the administration of one mCi of ^{99}Tc or colloidal ^{198}Au are compared. The storage and preparation of radioisotopes and labeled compounds are discussed. Data on the maximum concentrations of nine commonly used radioisotopes (^{198}Au, ^{57}Co, ^{60}Co, ^{51}Cr, ^{59}Fe, ^{197}Hg, ^{131}I, ^{32}P, and ^{99}Tc) that may be released into sanitary sewage systems are included. (11 references.) (C.H.)

50728 SCINTILLATION SCAN. Taplin, George V. (Univ. of California, Los Angeles). pp 119-57 of Clinical Scintillation Scanning. Freeman, Leonard M.; Johnson, Philip M. (eds.). New York, Harper and Row, Publishers, 1969.

The role of radioisotope scanning in medical practice and research is discussed. It is pointed out that the main value of scintiscanning comes from its unique capacity to visualize an ever-growing number of internal organs and localize lesions within such organs on the basis of their rejection or concentration of either nonspecific or cell-specific agents. Current developments in rapid imaging devices and test agents labeled with short-lived nuclides promise to expand this field of nuclear medicine into most areas of clinical practice and research. (15 references.) (C.H.)

50729 BRAIN. Zingesser, Lawrence H. (Albert Einstein Coll. of Medicine, New York). pp 158-202 of Clinical Scintilla-

tion Scanning. Freeman, Leonard M.; Johnson, Philip M. (eds.). New York, Harper and Row, Publishers, 1969.

The use of radioisotope scanning for the diagnosis of brain lesions is reviewed. The advantages and disadvantages of using ^{131}I-serum albumin, ^{203}Hg-chlormerodrin, mixtures of ^{197}Hg- and ^{203}Hg-chlormerodrin, and ^{99}Tc-pertechnetate as scanning agents are discussed. The use of ^{68}Ga-EDTA, ^{203}Hg-neohydrin, ^{199}Hg, and ^{113}In as scanning agents is also discussed. It is pointed out that the technique used depends on the availability of the various radioisotopes and scanning apparatus. Results using either ^{197}Hg-chlormerodrin or ^{99}Tc-pertechnetate and a rectilinear scanner with 31-hole collimator for the diagnosis and localization of benign and malignant brain neoplasms, blood vessel malformations, circulatory diseases, inflammation, trauma, and evaluating the results of therapy are described. (100 references.) (C.H.)

50730 CARDIOVASCULAR BLOOD POOL. Bonte, Frederick J.; Curry III, Thomas S. (Univ. of Texas, Dallas. Parkland Memorial Hospital, Dallas). pp 203-21 of Clinical Scintillation Scanning. Freeman, Leonard M.; Johnson, Philip M. (eds.). New York, Harper and Row, Publishers, 1969.

Radioisotope scanning of blood pools may be used to secure a number of kinds of medical information including the detection of pericardial effusions, the differential diagnosis of space-occupying lesions, ventricular aneurysms, mural thrombi, and for the delineation of other defects within blood pools. It is postulated that tumor scanning is largely based upon visualization of blood pools within tumors. The characteristics of ^{131}I-human serum albumin, ^{131}I-iodipamide, ^{99}Tc-pertechnetates, and ^{99}Tc-human serum albumin as blood pool scanning agents are discussed. Clinical results of blood pool scanning using ^{99}Tc-sodium pertechnetate are described. (22 references.) (C.H.)

50731 KIDNEY. Freeman, Leonard M. (Yeshiva Univ., New York). pp 222-59 of Clinical Scintillation Scanning. Freeman, Leonard M.; Johnson, Philip M. (eds.). New York, Harper and Row, Publishers, 1969.

The metabolism of chlormerodrin in the kidneys is discussed and the advantages and limitations of ^{197}Hg- and ^{203}Hg-labeled-chlormerodrin for scanning kidneys for function, inflammatory disease, and neoplasms are discussed. The kidney scan has also proved of value in the diagnosis of hypertension and renal trauma. The use of ^{131}I-hippuran and of ^{99}Tc-pertechnetate for kidney scanning is also discussed. (74 references.) (C.H.)

50732 LIVER. Johnson, Philip M. (Columbia Univ., New York. Presbyterian Hospital, New York. Harlem Hospital, New York. Dept. of Health, New York). pp 260-303 of Clinical Scintillation Scanning. Freeman, Leonard M.; Johnson, Philip M. (eds.). New York, Harper and Row, Publishers, 1969.

The use of radioisotope scanning of the liver to determine size, position, and configuration; for the identification of neoplasms; for the differential diagnosis of upper abdominal masses; for the evaluation of cirrhosis, abscesses, and occult lesions in conditions such as polycystic renal disease that may affect the liver; and for the localization of areas before surgical resection or radiation therapy and delineation of regeneration or repair following these procedures is discussed. The characteristics of various scanning agents are described, with emphasis on ^{198}Au colloid, ^{131}I-rose bengal, and ^{99m}Tc-sulfur colloid. The interpretation of typical liver scans is discussed. (59 references.) (C.H.)

50733 LUNG. Quinn III, James L.; Koch, Donald F. (Northwestern Univ., Chicago. Chicago Wesley Memorial Hospital). pp 304-25 of Clinical Scintillation Scanning. Freeman, Leonard M.; Johnson, Philip M. (eds.). New York, Harper and Row, Publishers, 1969.

The use of radioisotope scanning for the evaluation of pulmonary perfusion and lung ventilation is discussed. Iodine-131- or ^{99m}Tc-albumin macroaggregates are the agents most commonly used for perfusion scanning although indium-113-labeled $Fe(OH)_3$ and ^{133}Xe dissolved in saline may be used. For inhalation studies radioaerosols are administered to patients under positive pressure or ultrasonic nebulization. Aerosols that give satisfactory scans include ^{198}Au colloid, ^{131}I-albumin, and ^{99m}Tc-sulfur colloid. Combined perfusion and ventilation scans can be made simultaneously using ^{131}I-albumin macroaggregates and ^{99m}Tc-sulfur colloid. The value of lung scanning for the diagnosis of pulmonary embolus, emphysema, asthma, tuberculosis, and neoplasms, and for cardiovascular hemodynamic studies is discussed. (25 references.) (C.H.)

50734 OSSEOUS SYSTEM. Charkes, N. David (Temple Univ. Hospital, Philadelphia. Temple Univ. School of Medicine, Philadelphia); Sklaroff, David M. pp 326-83 of Clinical Scintillation Scanning. Freeman, Leonard M.; Johnson, Philip M. (eds.). New York, Harper and Row, Publishers, 1969.

The advantages and limitations of radioisotope scanning for the detection of occult tumors and neoplastic metastases in bones are discussed. The physical and biologic characteristics of ^{18}F, ^{68}Ga, ^{85}Sr, and ^{87}Sr for bone scanning are reviewed. It is pointed out that the chief drawback to the use of ^{68}Ga is the lack of sufficient data concerning the toxicity of Ga citrate used as the carrier, ^{18}F is not available in generator form, ^{87}Sr results in a high body background during the scanning period that may result in both false-positive and false-negative scans, and ^{85}Sr has many undesirable qualities related to its long physical half-life. The AEC has approved ^{85}Sr for use only in patients with known cancer. Calcium-47 has been used for the localization of primary and neoplastic bone cancer and Paget's disease, and for the localization of recent bone fractures. Especially designed scintillation counters and collimators are necessary when ^{47}Ca is used as the tracer. (81 references.) (C.H.)

50735 PANCREAS. Haynie, Thomas P. (Univ. of Texas, Houston). pp 384-96 of Clinical Scintillation Scanning. Freeman, Leonard M.; Johnson, Philip M. (eds.). New York, Harper and Row, Publishers, 1969.

Radioisotope scanning of the pancreas has proved to be difficult and to provide useful clinical data in only a limited number of cases. Difficulties that limit the value of pancreatic scanning are discussed. Selenium-75-labeled selenomethionine is the only radiopharmaceutical that has resulted in successful visualization of the pancreas. Dual-analyzer scanning, in which ^{75}Se-selenomethionine and ^{198}Au colloid are administered simultaneously and the γ emissions separated by pulse-height analysis, has been used to separate the pancreatic scan from the liver scan. The interpretation of pancreatic scans is made difficult by wide normal variations in the size and shape of the organ and by normal variations in the uptake of the tracer. Since the pancreatic scan is both an anatomic and a functional test, an abnormality in the scan may indicate either an anatomic lesion or a functional disorder. (22 references). (C.H.)

50736 PLACENTA. Nelp, Wil B.; Larson, Steven M. (Univ. of Washington, Seattle). pp 397-413 of Clinical Scintillation Scanning. Freeman, Leonard M.; Johnson, Philip M. (eds.). New York, Harper and Row, Publishers, 1969.

The use of ^{99}Tc-labeled albumin for the visualization of the placenta by photoscanning has proved to be a valuable method for the diagnosis of placenta previa and the management of patients who have vaginal bleeding during the latter stages of pregnancy. Results of placental scanning in 50 patients are summarized. (16 references.) (C.H.)

50737 SPLEEN. Johnson, Philip M. (Columbia Univ., New York. Presbyterian Hospital, New York. Harlem Hospital, New York. Dept. of Health, New York). pp 414-45 of Clinical Scintillation Scanning. Freeman, Leonard M.; Johnson, Philip M. (eds.). New York, Harper and Row, Publishers, 1969.

Scintillation scanning of the spleen, using ^{51}Cr-labeled erythrocytes as the tracer, provides a simple method to determine the anatomic location and structure of the organ, by exploiting the role of the spleen as the principal site of sequestration of damaged or effete erythrocytes. Erythrocytes labeled with ^{197}Hg are also used for spleen scanning. Heat damage of the erythrocytes increases maximum uptake by the spleen. The distribution of radioactivity is uniform in the normal spleen and space-occupying lesions, such as abscesses, cysts, hemangiomas, and malignant tumors appear on the scan as discrete inactive areas. The cause of an intrasplenic mass cannot be established by scanning. (34 references.) (C.H.)

50738 THYROID. Workman, Joseph B. (Univ. of Maryland, Baltimore. University Hospital, Baltimore). pp 446-67 of Clinical Scintillation Scanning. Freeman, Leonard M.; Johnson, Philip M. (eds.). New York, Harper and Row, Publishers, 1969.

Thyroid scanning, using ^{125}I, ^{131}I, or ^{99}Tc-pertechnetate for the diagnosis of hypothyroidism, hyperthyroidism, neoplasms and their metastases, and for the localization of ectopec thyroid tissue, is discussed. The administration of thyroid-stimulating hormone to increase the uptake of ^{131}I poorly functioning areas may improve the scan quality. (31 references.) (C.H.)

50739 PROGRESS IN SCINTILLATION SCANNING. Freeman, Leonard M. (Yeshiva Univ., New York). pp 468-507 of Clinical Scintillation Scanning. Freeman, Leonard M.; Johnson, Philip M. (eds.). New York, Harper and Row, Publishers, 1969.

Recent developments in radioisotope scanning are reviewed. Among the techniques discussed are: the use of ^{35}S and ^{75}Se-sodium selenite for the demonstration of chondrosarcoma; the use of ^{47}Ca, ^{18}F, and ^{85}Sr for the demonstration of other bone lesions; the use of ^{131}I-albumin for the diagnosis of malignant tumors throughout the body; the use of ^{197}Hg-chlormerodrin for

the diagnosis of malignant tumors of the nasopharynx; the use of intraarterial perfusion with hydrogen peroxide followed by intra-arterial infusion of ^{131}I-HSA or ^{197}Hg-chlormerodrin for the localization of neoplasms in various anatomic locations; the use of ^{99}Tc-pertechnetate, ^{75}Se-selenite, or ^{131}Cs to localize tumors in many anatomic sites; the use of ^{32}P to detect breast neoplasms; and the use of ^{131}I-fibrinogen or ^{131}I-labeled purified antibodies to human fibrinogen to localize various types of malignancies. Special techniques are described that have been developed for the radioisotope localization of cartilaginous tumors, lymphomas, and thymomas. Radioisotope scanning methods for the visualization of the parathyroid gland and diagnosis of parathyroid adenoma using ^{75}Se-selenomethionine; adrenal gland scanning using ^{131}I- or tritium-labeled-stigmasterol; detection of myocardial infarction in cardiac muscle by scanning using ^{131}Cs or ^{131}I-oleic acid; the visualization of capillary beds in various locations by scanning using ^{131}I-albumin macroaggregates; the localization of cardiac thrombi and pulmonary emboli by scanning using ^{131}I-labeled antibody to fibrinogen; the demonstration of porta-systemic shunts by scanning following intrasplenic injection of ^{131}I-albumin macroaggregates; the demonstration of blood vessel pathways throughout the body using γ cameras following the injection of a large dose of ^{99}Tc-pertechnetate; the use of ^{198}Au colloid, ^{99}Tc-sulfur colloid, or ^{153}Gd to locate functioning bone marrow by whole-body scanning; the use of ^{198}Au colloid scanning for the localization of lymph nodes; the use of ^{99}Tc-pertechnetate scanning for the localization of salivary glands; the visualization of the stomach by scanning using ^{131}I-iodide, ^{99}Tc-pertechnetate, or ^{131}I-toluidine red; visualization of the colon following intravenous injection of ^{99}Tc-pertechnetates; the use of ^{65}Zn-chloride for scanning the human prostate gland; the use of ^{131}I- or ^{99}Tc-labeled albumin for scanning bone joints; and the use of injections of ^{131}I-albumin for scanning the spinal canal of the central nervous system. (88 references.) (C.H.)

50740 PROSPECTIVE. Gottschalk, Alexander (Univ. of Chicago. Argonne Cancer Research Hospital, Chicago). pp 508-21 of Clinical Scintillation Scanning. Freeman, Leonard M.; Johnson, Philip M. (eds.). New York, Harper and Row, Publishers, 1969.

The role of radioisotope scanning in clinical diagnosis is reviewed. Limitations of the method are discussed and the outlook for the future is considered. (27 references.) (C.H.)

50741 MELANOMA DETECTION WITH RADIOIODOQUINE. Blois, Marsden S. (Stanford Univ. School of Medicine, Palo Alto, Calif.). J. Nucl. Med., 9: 492-3(Sept, 1968).

Iodine-131-labeled iodoquine was used for scanning patients for the diagnosis of malignant melanomas. The iodoquine was administered intravenously 40 to 200 hr before the planned time of counting. Potassium iodide was given orally to block the uptake of free ^{131}I by the thyroid. Sodium-22-labeled NaCl was administered five to 24 hr before counting. At the time of counting part of the iodoquine is bound to pigmented tissues and the major part is distributed throughout the body in a non-specific manner. The simultaneous use of ^{22}Na is used as a means of correcting for the counts from nonlocalized iodoquine. Counting is done with a scintillation detector, the output of which is fed into two analyzer-scalers adjusted to count separately the γ radiation of ^{131}I and the annihilation photons of ^{22}Na. Counts are made over several anatomical regions and the ratio of I/Na counts is used to correct the ^{131}I counts over regions that are suspect. A small scintillation probe detector is also used for counting around selected areas such as the eye. The advantages and limitations of the method are discussed. (C.H.)

50742 EVALUATION OF A NEW METHOD OF DETERMINATION OF THE GLOMERULAR FILTRATION RATE THROUGH METHYLGLUCAMINE RADIOACTIVE IOTHALAMATE. Mombelli, L.; Fidanza, M. A.; Roncari, G. (Univ., Milan). Acta Isotop., 8: 21-9(1968). (In Italian).

A procedure is described for the evaluation of glomerular filtration rate of kidneys by radioisotope scanning using ^{131}I-labeled methyl glucamine iothalamate. (C.H.)

Radiotherapy

Refer also to abstracts 49998, 50484, 50485, 50491, 50500, 50503, 50509, 50529, 50543, 50554, 50557, 50629, 50648, 50811, 50891, 50893, 50894, 50896, 50898–50900, 50902–50908, 50911–50915, 50918, 50923, and 52075.

50743 THE LONG-ACTING THYROID STIMULATOR (LATS) IN UNTREATED AND ^{131}I-TREATED HYPERTHYROIDISM, AFTER TOTAL THYROIDECTOMY, AND ITS RELATION TO THYROID ANTIBODIES. Ziemke, A.; Weisbecker, L.; Uthgenannt, H.; Schemmel, K.; Mueller, W.; Heesen, H.; Eickenbusch, W. (Univ., Kiel). Klin. Wochensch., 46: 1025-7(Oct. 1, 1968). (In German).

The effect of ^{131}I treatment of 27 hyperthyroid patients on long-acting thyroid stimulator (LATS) and thyroid antibodies was followed. Determination of LATS in hyperthyroid patients either treated with ^{131}I or untreated did not reveal any correlation between therapy with ^{131}I and occurrence of LATS. Also in control patients no correlation could be established, either before or after therapy with ^{131}I. However, a clear-cut relation between the occurrence of LATS and that of thyroid antibodies could be demonstrated. After total thyroidectomy LATS significantly decreased. (BBB)

50744 PITUITARY ABLATION, INSULIN DOSAGE, AND COURSE OF DIABETIC RETINOPATHY. Danowski, T. S.; Sabeh, G.; Alley, R. A.; Robbins, T. J.; Sarver, M. E.; Parsons, J. A.; Susen, A. F.; Narduzzi, J. V. (Univ. of Pittsburgh). Metab., Clin. Exp., 17: 953-65(Nov. 1968).

Clinical results and complications of pituitary ablation by x irradiation (700 to 10,000 R) in 13 patients and by transphenoidal hypophysectomy in 24 others are reported. With one exception, irradiation of the pituitary was not associated with any untoward clinical signs of symptoms. One patient developed nervousness, tachycardia, decrease in body weight, serum PBI of 13.9 μg%, and 24-hr thyroidal ^{131}I uptake of 70%. None of the 13 patients treated with supervoltage x rays developed any sign of reduction of pituitary function judging by the maintenance of normal plasma free 11-hydroxycorticoids, serum PBI, thyroidal ^{131}I uptake, urinary 17-ketosteroid, Porter-Silber chromogen, and gonadotropin levels. Insulin requirements were not reduced. This trial of supervoltage x irradiation of the pituitary yielded no evidence of a beneficial effect on vision-threatening diabetic retinopathy. The dose employed through four ports was in excess of the 3000 to 5900 R employed in earlier studies with negative or equivocal results, indicating that the pituitary is relatively resistant to large doses of x rays. (BBB)

50745 MEDICAL RADIOBIOLOGY AND MODERN THERAPEUTICS TREND TOWARD INTEGRATION. Revesz, L. (Karolinska Institutet, Stockholm). Nord. Med., 78: 1435-42 (Nov. 2, 1967). (In Swedish).

It is pointed out how advances in radiotherapy have followed an empirical approach rather than discoveries in radiobiology, and how imperative it is that these discoveries be applied in the future to medical problems. A shift in emphasis from empirical to rational practice, new theories, and new concepts is needed rather than new data or new tools. In support of this thesis, some examples from the history of radiotherapy are given. One example considered is the possibility of neoplastic tissues being more sensitive to radiation than the surrounding normal tissue. A second example is development of methods of increasing the sensitivity of resistant tumor cells, or protecting the normal tissue. The third example shows how an attempt to explain the efficacy of radiotherapy in radiobiological terms was delayed until a breakthrough in all methods of examining recovery from sublethal damage. Various basic mechanisms of action, oxygen effect, fractionation, and all population kinetics are discussed in relation to radiotherapy. The fact that dose-effect relation as established by simple survival curve models may not be relevant in all cases is considered. Another problem which cannot be approached by simple survival curve models is presented by the heterogeneity of neoplasms. By taking advantage of the progress in cellular and supracellular radiobiology, it should be possible to define more and more the functional and morphological parameters that are of radiotherapeutic importance for a particular case. Several examples are examined. (BBB)

50746 TREATMENT OF MALIGNANT SUPERIOR VENA CAVAL OBSTRUCTION. Levitt, S. H. (Medical Coll. of Virginia, Richmond); Jones, T. K. Jr.; Kilpatrick, S. J. Jr.; Bogardus, C. R. Jr. Cancer, 24: 447-51(Sept. 1969).

A clinical trial of 2 methods of treating malignant superior vena caval obstruction is presented. Twenty-eight selected patients were allocated to treatment with radiation and nitrogen mustard or radiation alone according to a strictly administered randomization scheme. It appears that there is no apparent advantage to the use of nitrogen mustard prior to irradiation. It would appear that, in view of the side effects of nitrogen mustard, the use of the initially high daily dose radiation technique, combined with judicious use of diuretics, would be preferable. (auth)

50747 THE 89th ANNUAL SESSION OF THE AMERICAN SURGICAL ASSOCIATION, CINCINNATI, OHIO, APRIL 30–MAY 2, 1969. Ann. Surg., 170: 309-514(Sept. 1969). (CONF-690424).

Separate abstracts were prepared for two papers in this con-

ference. Sixteen additional papers on various aspects of surgical techniques are included. (H.L.W.)

For abstracts of individual papers see: 50656 and 50893.

50748 LASER IN MEDICINE AND BIOLOGY: AN APPRAISAL. Nunn, W. M. Jr.; Litwin, Martin S. (Tulane Univ., New Orleans). Mil. Med., 134: 591-6(Aug. 1969).

Physical processes underlying the production of laser energy are examined, in order to better define medical and biologic applications of this important region of the electromagnetic spectrum. Since laser wavelengths encompass a region of the spectrum where cellular constituents exhibit strong absorption bands, precisely determined amounts of laser energy provide a possible means for selectively ionizing biologic materials of importance in the life processes of cells. Clinical usage should at present be restricted to retinal photocoagulation. While the potential for other clinical applications may exist, until substantially more relevant medical and biologic knowledge is accumulated, lasers should be regarded as basic scientific instruments rather than clinical tools. (auth)

50749 LIVER IRRADIATION IN CHILDREN: ACUTE CHANGES WITH TRANSIENT LEUKOPENIA AND THROMBOCYTOPENIA. Tefft, M.; Traggis, D.; Filler, R. M. (Harvard Medical School, Boston). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 106: 750-65(Aug. 1969).

Four patients are described who manifested unusual reactions to combined irradiation and chemotherapy when irradiation of the liver was involved. Two had had partial resection of the liver and irradiation of all of the remaining liver tissue; each of the others, with an intact liver, may have had compromise of liver function by infection and/or by lower dose irradiation of the left lobe of liver. We suggest that irradiation of the liver, especially in patients who receive chemotherapeutic agents that may require liver for detoxification or excretion, be very carefully administered, even at a minimal dose. Any underlying compromise of the liver must be evaluated carefully. In each patient, hemoglobin levels were normal throughout the clinical course. (auth)

50750 RADIATION PROTECTION OF VITAL ORGANS, USING A SELECTIVE ARTERIAL CATHETER. EXPERIMENTAL AND CLINICAL ASPECTS. Steckel, Richard J.; Tobin, Peter; Ross, Gordon; Stein, Justin J.; Stevens, Gary H. (Univ. of California, Los Angeles). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 106: 841-7(Aug. 1969).

Experimental attempts to extend the technique of organ radiation protection during therapy with epinephrine infusion administered by a percutaneous arterial catheter to the small bowel, are detailed. Although results to date are inconclusive, further studies are warranted. Preliminary results from a pilot clinical study of unilateral radiation protection of the kidney are also presented in the form of a case report. (auth)

50751 CELLULAR CHANGES IN THE CONJUNCTIVA AFTER ^{90}Sr TREATMENT FOR PTERYGIUM. Tong, Eddy C. K.; Zaret, Milton M.; Rubenfeld, Sidney (New York Univ., N. Y. Zaret Foundation, Inc., Scarsdale, N. Y.). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 106: 848-53(Aug. 1969).

Sixty-two patients with pterygium were treated by ^{90}Sr β radiation postoperatively with doses of 1,000 reps weekly for three weeks and were evaluated by naked eye, slit-lamp, and cytologic examinations. Complications from β irradiation were mild. Ten per cent of the patients had recurrences of the pterygium two to 18 months after completion of the first course of the treatment. Only 1.2% of the pterygia recurred after the second course of therapy. Distinct cellular changes were observed in the irradiated conjunctiva. The changes were those of polymorphism, giant cell formation and chromatin abnormalities. Despite the persistent change of the cells, no serious sequelae in the conjunctiva were found as long as 11 yr after radiation therapy. (auth)

50752 IMMEDIATE RESULTS OF RADIATION AND COMBINED TREATMENT OF PULMONARY CANCER. Isaev, M. S. (Research Inst. of Roentgenology, Radiology, and Oncology, Baku). Vop. Onkol., 15: No. 6, 74-9(1969). (In Russian).

The immediate results of radiation, chemotherapy, and combined radiation with chemotherapy treatment of pulmonary cancer are reported. The results of the studies demonstrated that the use of chemical agents (cyclophosphan and thio—TEPA) prior to and during radiation therapy in pulmonary cancer provides more favorable results than x-ray therapy alone or radiation with subsequent chemotherapy. In some cases chemotherapy per se provides only temporary arrest of tumor growth and improves patients' condition. (auth)

50753 RADIATION TREATMENT IN RENAL CANCER: A REVIEW. Vohra, V. G. (Tata Memorial Hospital, Bombay). Indian J. Cancer, 5: 62-7(Mar. 1968).

Tumors of the kidney such as renal carcinomas and cancers of renal pelvis, are highly resistant to radiation, whereas Wilm's tumor is highly sensitive. Neither of them can however, be cured by radiation alone. Early renal cancers are treated by nephrectomy. Late renal cancers, when not so treated, cannot be effectively treated by radiation. Wilm's tumors can be treated by radiation palliatively for reduction of size, control of pain, etc., but no cure is possible by radiation alone. (auth)

50754 BIBLIOGRAPHY ON CANCER, 1957–1967. Mathkar, V. M. (Tata Memorial Hospital, Bombay). Indian J. Cancer, 5: 340-76(Dec. 1968).

A list is presented of 1158 articles on cancer published in Indian medical journals and articles by Indian authors published in foreign journals between 1957 and 1967. (C.H.)

50755 ^{131}I TREATMENT FOR TOXIC DIFFUSE GOITER: ANALYSIS OF 1056 CURED CASES. Yang, Hsueh-fang; Chen, Fan-wu; Chen, Chung-ching (National Taiwan Univ. Hospital, Taipei). T'ai-wan I Hsueh Hui Tsa Chih, 68: 94-105(Feb. 28, 1969).

Means of preventing hypothyroidism, as a serious postirradiation complication of radioiodine treatment of thyrotoxicosis, are considered and results of ^{131}I therapy in 1496 cases were analyzed. A single dose of ^{131}I cured 45% of the patients, and 92% were cured with three doses or less. Eight percent of patients were moderately resistant to radioiodine and required more than three doses to attain the euthyroid state. Three cases of hyperthyroidism showed complete resistance to radioiodine and were thyroidectomized after administration of several doses of ^{131}I. Incidence of postirradiation hypothyroidism was 7.9%, but will probably rise with the passage of time. To prevent postradioiodine hypothyroidism, further studies are required to determine the optimal dose of ^{131}I. The authors propose two principles: long-term medical treatment with antithyroid drugs for patients with mild thyrotoxicosis or small goiter instead of ^{131}I treatment, and cautious administration of an additional dose of ^{131}I when previous treatment with ^{131}I seems inadequate. To avoid prolongation of therapeutic period in cases resistant to radioiodine, ^{131}I should not be given to patients with unusually large goiters and patients should by thyroidectomized if the effect of ^{131}I is not apparent after three doses of ^{131}I. (BBB)

50756 STUDY OF POSSIBLE FACTORS INDUCING HYPOTHYROIDISM AFTER ^{131}I TREATMENT IN HYPERTHYROIDISM. Chen, Fang-wu (National Taiwan Univ., Taipei). T'ai-wan I Hsueh Hui Tsa Chih, 68: 63-80(Feb. 28, 1969).

Clinical results of ^{131}I treatment of hyperthyroidism in 316 patients were analyzed to examine factors which may lead to induction of hypothyroidism, a serious complication of radioiodine therapy. The incidence of hypothyroidism was higher (16.3%) in patients older than 40 yr of age compared to that (7.3%) in cases younger than 40 yr of age. The mean age was 43.7 yr for hypothyroid cases and 38.9 yr for euthyroid cases. The incidence of hypothyroidism was 13% for cases with gland smaller than 50 g and 9.7% for cases with gland larger than 50 g. The incidence of hypothyroidism was 18.5% for cases with 24 hr ^{131}I thyroid uptake lower than 50% and 9.4% for cases with values higher than 50%. The incidence of hypothyroidism in postoperative recurrent cases was 11.1% and it was 3.4% in antithyroid drug pretreated cases. Since a high incidence of hypothyroidism in cases older than 40 yr was found, hyperthyroid patients older than 40 should be treated with smaller than usual dose, especially if they have a 2-hr uptake value lower than 50%. Cases never having received any previous treatment should also be treated with smaller dose. In postoperative recurrent cases, a smaller dose of ^{131}I should be employed, and in cases with a large gland and high 24 hr uptake the usual dose or even more may be given. Then, if necessary, antithyroid drugs or potassium iodide may be given to minimize the symptoms and the incidence of hypothyroidism. (BBB)

50757 INTRAVASCULAR PARTICULATE RADIOISOTOPE THERAPY: CLINICAL OBSERVATIONS OF 76 PATIENTS WITH ADVANCED CANCER TREATED WITH ^{90}Y PARTICLES. Nolan, Thomas R.; Grady, Edgar D. (Piedmont Hospital, Atlanta). Amer. Surg., 35: 181-8(Mar. 1969).

Radiation effects, clinical effects, and complications in ^{90}Y treatment of metastatic cancer are reported. Yttrium-90 in the physical form of Y_2O_3 particles 50 to 100 μ in the largest dia provided β radiation with maximum penetration in soft tissues of 12 mm, and an average penetration of 3.6 mm. The radiation characteristics of ^{90}Y preparation are such that 27 or more particles per cm^3 of tissue produces a nearly uniform field of radiation within a mass of tissue in which the particles are evenly dispersed. There are about 900 particles in each mg of dry $^{90}Y_2O_3$ powder, and when 70 mg was injected intravenously into a patient there were 63 particles per g of lung, producing radiation through-

out the organ. The irradiation lasts effectively for seven half lives or nearly 3 weeks, although 87% is delivered in the first 8 days. In animal studies, tissue and whole-body tolerance was determined by observations after injections based on body weight. Calculated doses up to 8 mCi/Kg were tolerated, and initially similar doses were given to patients, but such calculations proved grossly inaccurate. Doses above 2 mCi/Kg were excessive, particularly in the lungs. The estimated lung dose was about 23 Krad. In 38 of 78 patients there was objective evidence of tumor regression, 30 of whom also had subjective improvement. Complications occurred in 30 patients after initial injection, mostly in the immediate posttreatment period, but some delayed many months. Complications appeared after a second injection in three additional patients; two died. Four patients received two injections each without complications; none received more than two. Some untoward effect therefore took place after two of five injections. Of the 33 instances of complications, 13 resulted in death soon after treatment and in two others the late appearance of intestinal fibrosis ultimately led to death. Of the 13 early complications that led to death, eight were due to pulmonary edema after lung treatment, one of which occurred unexplainably after unilateral pulmonary artery injection. Two were instances of ileus, shock, and death after upper abdominal aortic injection. Some of the nonfatal complications were transient, some resulted in permanent impairment. (BBB)

50758 THE EFFECT OF RADIOABLATION OF THE THYROID GLAND IN GRAVES' DISEASE WITH HIGH LEVELS OF LONG-ACTING THYROID STIMULATOR (LATS). Volpe, Robert; Desbarats-Schonbaum, Marie-Louise; Schonbaum, Eduard; Row, Vas V.; Ezrin, Calvin (Univ. of Toronto). Amer. J. Med., 46: 217-26(Feb. 1969).

The effect of large doses of ^{131}I (up to >100 mCi) was evaluated in a clinical experimental study of 13 patients with Graves' disease, ophthalmopathy, and (in five cases) pretibial myxedema, on the basis of previous suggestions that high-dose ^{131}I therapy might ameliorate the ophthalmopathy and dermopathy. All patients were treated with conventional doses of ^{131}I for their hyperthyroidism 1 to 8 yr previously and were either euthyroid or (controlled) hypothyroid at the time of radioablation. The patients were selected on the basis of persistent high titers of LATS (long-acting thyroid stimulator). Initial doses of 60 to 100 mCi were given, and in two cases additional doses of 50 and 60 mCi, respectively. Complete ablation was not always attained even with large and sometimes repeated doses of ^{131}I. With a 1-mCi scanning dose, complete ablation seemed to be achieved in four patients; however, with TSH (thyroid-stimulating hormone) and a 5-mCi dose, residual thyroid parenchyma was demonstrated in two of these four. In the 11 patients with such minimal residual functioning thyroid parenchyma, the 24-hr radioiodine uptake values were less than 1% in each patient. Thyroxine therapy was administered to all. After 2 yr none of these patients showed significant change in the ocular manifestations or pretibial myxedema. There were no significant changes in LATS titers. Thyroid autoantibodies, present in five, declined in every instance, twice to zero. Apart from the decline in thyroid autoantibodies, therefore, there was no demonstrable effect of total thyroid ablation in terms of the exophthalmos, pretibial myxedema, or LATS assays. It is suggested that removal of the thyroid antigen does not cause LATS to decline significantly. (BBB)

50759 PLACE OF RADIUM THERAPY. Bickenbach, W. (Univ., Munich). Med. Gynaecol. Sociol., 4: 30-5(Feb. 1969).

Various plans of Ra and ^{60}Co intracavitary radiotherapy for endometrial carcinoma and the effectiveness of various dose schedules are compared. The dose is empirically determined. A total of 6000 to 7000 mg-hr of Ra is recommended, divided into three doses of 2000 mg-hr given at intervals of 10 to 14 days. If indicated, 1000 mg-hr is additionally given to the vagina. At approximately the point where the uterus is widest and at a distance of 3 cm from the longitudinal axis, this dose corresponds to 5000 to 6000 rad. No correlation was found to exist between the dose and the survival rate. From 3000 to 7000 mg-hr the coefficient of correlation between the dose and the survival rate was −0.0772, i.e., there is practically no correlation. The individual variability, both with regard to the malignancy of the carcinoma and the general physical condition of the patient, tends to mask the effect of differences in dose. Isodose patterns for various Ra arrangements are shown. In the pre-operative treatment of endometrial carcinoma with intracavitary Ra, a single dose of 2400 to 3000 mg-hr is applied about 3 to 4 weeks before the operation. External radiation of the lymphatics may also be used. The tumor cells will be devitalized and thus decrease the possibility of metastatic spread during operative manipulations. (BBB)

50760 MAGNETIC AND THRESHOLD TECHNIQUES FOR ENERGY CALIBRATION OF HIGH-ENERGY RADIATIONS. Lanzl, Lawrence H. (Univ. of Chicago. Argonne Cancer Research Hospital, Chicago. International Atomic Energy Agency, Vienna). Ann. N. Y. Acad. Sci., 161: 101-18(July 3, 1969).

From Conference on High Energy Radiation Therapy Dosimetry, New York. See CONF-670665.

Energy calibration problems associated with electron and x-ray beams from travelling-wave linear accelerators and betatrons are discussed. (B.G.D.)

50761 ENERGY CALIBRATION OF BETATRON X-RAYS AND ELECTRONS UP TO 40 MeV. Pohlit, W. (Max Planck Institut fuer Biophysik, Frankfurt am Main). Ann. N. Y. Acad. Sci., 161: 119-32(July 3, 1969).

From Conference on High Energy Radiation Therapy Dosimetry, New York. See CONF-670665.

The energy calibration of a betatron has to be performed with a precision adequate to the experiments planned with that accelerator. For nuclear research or problems in radiation physics, uncertainties in the absolute value of the energy should be less than about ±50 keV in the range from 10 to about 40 MeV. Short time fluctuations from pulse to pulse should be less than about ±5 keV, and a long-time deviation, for example, one due to the warming up of the accelerator over many hours, should not exceed ±50 keV. For medical applications of a betatron, less strictness is necessary. If an external electron beam is used, the absolute value of the energy should be known within ±250 keV, and the energy should be stable also within those limits. For the application of high-energy x-rays, uncertainties up to 2 MeV are unimportant. In the following, some easy and improved methods for the energy calibration of a betatron are discussed. (auth)

50762 COMPREHENSIVE ELECTRON-BEAM TREATMENT PLANNING. Dahler, Arne (Memorial Hospital for Cancer and Allied Diseases, New York. Norwegian Radium Hospital, Oslo); Baker, Alan S.; Laughlin, John S. Ann. N. Y. Acad. Sci., 161: 198-213(July 3, 1969).

From Conference on High Energy Radiation Therapy Dosimetry, New York. See CONF-670665.

A report on electron-beam planning based on experience with both the electrons in the 6- to 24-MeV range from the Allis-Chalmers betatron and those in the 15- to 35-MeV range from the Brown-Boveri betatron is presented. It is based primarily on treatment-planning experience in the United States, particularly as applied at the Memorial Hospital in New York since 1955. The treatment planning method in use at Memorial Hospital provides a systematic method for determining the actual dose distributions in a patient, taking into consideration wedges, surface irregularities, and tissue inhomogeneities. (B.G.D.)

50763 RADIOBIOLOGY AND RADIOTHERAPY. Wideroee, R. (Brown, Boveri and Co. Ltd., Baden, Switzerland. Swiss Federal Technical Inst., Zurich). Ann. N. Y. Acad. Sci., 161: 357-67(July 3, 1969).

From Conference on High Energy Radiation Therapy Dosimetry, New York. See CONF-670665.

Even if the radiobiologic results today seem divergent and partly contradictory, some useful conclusions for radiotherapy can still be drawn. The two-component theory of radiation so far can explain most experiences with different radiations and also helps understanding of the oxygen-enhancement ratio. In radiotherapy, the parameters might vary to a much higher degree than they do in cell cultures, the average values being, however, similar to the in vitro measurements. Electiveness between the normal cells in the tumor bed and the tumor cells is of utmost importance and can be increased considerably by using high single doses of high-energy electrons. A treatment program based upon such principles that has proved highly successful in many cases is described and evaluated. (auth)

50764 EXPERIENCE WITH A DOSE DISTRIBUTION COMPUTATION SERVICE. Holt, J. G.; Balter, S.; Baker, A.; Laughlin, J. S.; Phillips, R. F. (Memorial Hospital for Cancer and Allied Diseases, New York). Ann. N. Y. Acad. Sci., 161: 344-7(July 3, 1969).

From Conference on High Energy Radiation Therapy Dosimetry, New York. See CONF-670665.

A practical linkage system that makes the computation part of treatment planning available at low cost to collaborating hospitals has been developed. The objective is to provide dose distribution plans for external beam therapy and interstitial and intracavitary therapy. The computer-assisted computations permit consideration of the effects of surface curvature, lung tissues, bony structure, and external obstructions in the radiation beam. Ordinary telephone lines and teletypewriters are used. Treatment plan specifications are sent in, computation of the radiation dose distribution that would be produced by

this plan is done and the resulting dose distribution is transmitted back to the originating institution. A normal turn-around time is 24 hr, but faster service can be obtained when needed. About 30 treatment plans per month are computed. It is concluded that experience has demonstrated the feasibility of a practical linkage system for establishing a computation network. (C.O.)

50765 DOSE-RATE EFFECTS. Roesch, W. C. (Battelle-Northwest, Richland, Wash.). Contract AT(45-1)-1830. Ann. N. Y. Acad. Sci., 161: 354-6(July 3, 1969).

From Conference on High Energy Radiation Therapy Dosimetry, New York. See CONF-670665.

Survival curves are presented on the basis of a modified hit theory (including recovery effects) using different dose rates. Survival decreased with increasing dose rate. However, the curves lie closer together as the rate increases, so survival does not decrease without limit. Using these relations as a model, achieving a differential effect due to changes in dose rate would require large doses, because at low doses the different curves lie too close together. Relatively low dose rates are necessary for rate effects, because the difference expected from changing the rate at high dose rates is less than that at low dose rates. In therapy, dose-rate effects are seldom seen at the dose rates employed. From the model, it would seem that the dose rates are too high and/or the total doses (per fraction) are too low to see the effects. A possible application of the dose rate effect is suggested. This would employ simultaneous three-port irradiation where the dose rate in the overlap area would be three times the rate of separate irradiations and three times that in surrounding tissues. The need for penetrating radiation is emphasized. It is concluded that studies with conventional x radiation are feasible. (C.O.)

50766 TREATMENT PLANS IN HOMOGENEOUS TISSUE, USING ELECTRONS OF 15 TO 37 MeV. Ovadia, Jacques (Michael Reese Hospital and Medical Center, Chicago). Ann. N. Y. Acad. Sci., 161: 243-53(July 3, 1969).

From Conference on High Energy Radiation Therapy Dosimetry, New York. See CONF-670665.

Two treatment plans were used to illustrate the dose distribution that can be achieved with electrons in the energy range of 15 to 37 MeV, and to point out some of the problems and pitfalls of this form of therapy. The plans selected were for the treatment of axillary and supraclavicular nodes in the management of carcinoma of the breast and for irradiation of pituitary adenomas. The dose distributions were determined for homogeneous tissue. The applicability and the net effect of a correction for the bone heterogeneity in the pituitary treatment plan is also discussed. (auth)

50767 WHAT IS NEW IN RADIOTHERAPY. Singh, A. D. (Christian Medical Coll., Vellore, India). J. Indian Med. Ass., 50: 567-71(June 16, 1968).

Recent advances in radiotherapy are reviewed under the following topic headings: design of new apparatus, dosimetry, protection against radiation, nuclear medicine, and radiobiology. Prevention of side-reactions by new techniques and radiation sources is explained. Hazards to radiotherapy personnel handling radioisotopes and minimizing them by use of distance, brief handling time, and shielding are dealt with. Personnel exposure should be below 100 mR per week to the vital organs and below 1500 mR per week to the hands and feet. Use of ^{60}Co, ^{137}Cs, ^{131}I, ^{198}Au, ^{90}Y, ^{32}P, ^{90}Sr, and ^{178}Ta in nuclear medicine is mentioned. The concepts of LET and RBE are explained and exemplified for different radiations. Use of radiation synergists and sensitizers, particularly hyperbaric oxygen, in radiotherapy are discussed. Future developments in radiotherapy are speculated upon. (BBB)

50768 RADIO-OPHTHALMOLOGY IN THE THERAPY OF POSTERIOR FUNDUS TUMORS. Bedford, M. A. (St. Bartholomew's Hospital, London). Proc. Roy. Soc. Med., 61: 1041-2 (Oct. 1968).

Attention is given to preventing radioinjury of the eye in using 3 types of irradiation for eye tumors. Cobalt-60 plaques are discs of the isotope sealed in platinum with projecting lugs which can be sewn onto the sclera after localization. They prevent the very hot spots given by Rn seeds when sewn onto the outside of the eye to give an adequate dose to the tumor within. The side-effects were frequent and much scarring ensued, so that today their use is not justified. Cobalt-60 plaques with their localized irradiation dose are the ideal treatment for the optimum-sized tumor. In 1 week a plaque will deliver a lethal dose of 4000 R to the tumor cells with very little involvement of the adjacent tissues. The underlying choroid and sclera receive enormous doses which are relatively well tolerated. Side-effects are few with the exception that the plaques, when applied near the optic nerve, may cause hemorrhages or exudates from the large retinal vessels months later. With ^{60}Co teleradiation a direct anterior field is used and the relevant isodose curve occupies the greater part of the eye including the lens. The optic nerve does not receive a high dose of radiation. All cases develop radiation cataract in 2 yr. Because of this complication other techniques have been developed, particularly the use of the linear accelerator. With this device the source of radiation is tilted horizontally and with the sharp cut-off the lens and the retrolental portion of the vitreous may be spared. Problems considered when using this method of treatment include the buildup of adequate tumoricidal dose to the retina on the temporal side and also the dose that the other eye receives. (BBB)

50769 ^{125}I TREATMENT FOR THYROTOXICOSIS. Greig, W. R.; Smith, J. F. B.; Gillespie, F. C.; Thomson, J. A.; McGirr, E. M. (Royal Infirmary, Glasgow). Lancet, 1: 755-7(Apr. 12, 1969).

The problem of late-occurring hypothyroidism as a sequelae to the radioiodine treatment of thyrotoxicosis was considered, and clinical studies using ^{125}I rather than the usual ^{131}I are reported. Postirradiation hypothyroidism seems to be primarily the consequence of irreversible follicular-cell depletion arising from radiation damage to cell nuclei with cessation of cell replication and renewal. Iodine-125 therapy was considered to be worth evaluating because the low-energy electrons and x rays should deliver much more irradiation to the parts of the follicular cells that synthesize the excess hormone than to the nucleus of the same cells. Doses necessary to curtail excess hormone secretion without encroaching on follicular-cell viability through chromosmal damage might thus be more feasible with ^{125}I. Dose distributions for the two isotopes are compared. The relative dose (rad) due to ^{131}I is uniform across the cell whereas the dose due to ^{125}I is higher in the part of the cell synthesizing hormone than in either the cell nucleus or the interfollicular space. It was estimated that the nuclear dose is reduced by up to 80% if ^{125}I is used to treat thyrotoxicosis. In the 10 patients with thyrotoxicosis that were treated the mean oral dose of ^{125}I was 38.2 mCi, compared with a mean dose of about 10 mCi of ^{131}I that would have been given in routine therapy. All 10 patients became euthyroid, eight within 10 weeks and the other two within 12 and 20 weeks. Thus, ^{125}I given in doses four times as great as conventional doses of ^{131}I resulted in rapid and predictable control of thyrotoxicosis. The only side-effect present in three patients and noted 2 to 6 weeks after therapy, was slight dysphagia and thyroid tenderness. Serial peripheral white-blood-cell counts were constant in all patients. At present, ^{125}I therapy for thyrotoxicosis should be used only in carefully supervised clinical trials. (BBB)

50770 RADIATION HEART DISEASE. J. La. State Med. Soc., 120: 243-5(May 1968).

A study reporting 21 cases with radiotherapy-induced heart injury is briefly reviewed. Eleven patients had received radiotherapy for Hodgkin's disease, five for carcinoma of the breast, and one each for malignant thymoma, metastatic carcinoma of the cervix, round cell tumor of the rib, carcinoma of the esophagus, and recticulum cell sarcoma. Three patients received 1525, 2500, and 3100 rad. The others received 4000 to 7000 rad except for the one who received 8950 rad. Acute pericarditis was diagnosed in 13 patients. In two, acute pericarditis developed during the initial course of radiotherapy, after 1500 and 3100 rad. Acute pericarditis developed in 11 patients after completion of irradiation. Among these it appeared in 5 to 12 months in six, and 2 to 4 yr later in five. Four of the 11 patients later developed chronic constriction. Eleven patients showed chronic pericardial disease, and were grouped as follows: uncomplicated chronic pericardial effusion; chronic constrictive pericarditis with various degrees of active inflammation and chronic pericardial effusion; chronic constrictive pericarditis with myocardial and endocardial fibrosis without pericardial effusion. The importance of recognizing radioinduced cardiac disease and distinguishing it from tumor recurrence is emphasized. (BBB)

50771 ISOTOPE DIAGNOSIS AND THERAPY OF POLYCYTHEMIAS AND LEUKEMIAS. Benassi, E.; Torretta, A. (Univ., Turin). Muenchen. Med. Wochenschr., 110: 765-74 (Mar. 29, 1968). (In German).

Pathological alterations of the blood cell pattern induced by ^{32}P treatment of polycythemia were discussed. The changes reported were infrequent and often were difficult to differentiate from the original pathological changes due to the disease. They were of three types. In the late stages of polycythemia ^{32}P effects included decreases in bone marrow function, myelosclerosis, and leukemia. These changes may have resulted partly from the disease as well as from the ^{32}P treatment. Their appearance could have been associated with the increased life extension in the treated patients. Therapy with ^{32}P increased polycythemia patient survival for up to

13 yr, so that development of myelosclerosis or leukemia in surviving patients may have been a normal transition from polycythemia instead of a direct response to ^{32}P treatment. Examination of numerous statistics indicated that applications of radioisotopes for therapeutic purposes were undervalued, and the benefits may outweigh by far the risks of injuries from their use. (BBB)

50772 CATHETRON: A NEW WORD IN THE FIELD OF MEDICINE. Wares, Elizabeth (Charing Cross Group of Hospitals, London). Nursing Times, 64: 1585-7(Nov. 22, 1968).

A new method and instrumentation that reduces the personnel radiation exposure in treatment of uterine cervical cancer with Ra are described and illustrated. In this afterloading technique specially designed equipment, the Cathetron is used. This device overcomes the disadvantages of earlier methods of treatment. The patient is set up for treatment by introducing and fixing hollow steel catheters to the desired position in the uterus and vagina; they are then connected to a protective safe by hollow cables. The staff withdraws from the treatment room, that is fully shielded by a 2 ft 3 in. concrete wall. An electrical mechanism is activated that moves the radiation sources from the safe to the patient. At the conclusion of the treatment, the sources return automatically to the safe. Because the sources are about 100 times more intense than Ra sources hitherto used, former treatment times of 24 hr can be reduced to about 3 min. This means that treatment can be achieved while staff waits outside the room. In this way there is no hazard to staff: only the patient receives the radiation. The instruments used are a modification of a dilatation and curettage set, plus specially made tubular metal catheters to take radiation sources and stainless steel apparatus to hold these tubes in situ. The catheters are connected by flexible tubes to the safe containing the radiocobalt sources. The advantage of this form of treatment is lack of radiation hazard, both to hospital personnel and visitors to the ward. There is no chance of radiation sources falling out of position, an unlikely but possible risk in the case of Ra insertion. By eliminating radiation hazard it allows the patient greater freedom of movement. (BBB)

50773 TRITIATED THYMIDINE STUDIES OF RADIATED LARYNGEAL CANCER. Friedman, William H.; Goldman, Joseph L. (Mount Sinai School of Medicine, New York). Arch. Otolaryngol., 89: 766-9(May 1969).

Biopsy cell uptake of ^{3}H-thymidine was used for clinical evaluation of the effectiveness of radiotherapy on advanced cancer of the larynx. Four patients with cancer of the larynx classified as stage III were studied. In vitro labeling of biopsy specimens of cancer taken at specified intervals during the course of preoperative radiotherapy and in pathological specimens removed at the time of surgery was determined. Slices of tissue were incubated for 30 min in tissue culture media containing 1 μCi/ml of tritiated thymidine. The 30 min in vitro exposure time included only a small fraction of the mammalian cell cycle. Thymidine is incorporated exclusively into DNA during the 8-hr S or synthesis phase of the cycle. Therefore, only those cells in the S phase, or those cells actively synthesizing DNA, incorporated thymidine and became tagged with the attached tritium. In each patient the control biopsy taken in radiotherapy showed heavy labeling. As many as 8 to 10 cells per high power field were labeled, with grain counts ranging from 10 to 30 grains per labeled cell. Following 3500-rad of ^{60}Co teletherapy, there was in each case a marked reduction in both the numbers of labeled cells per high power field, and in the number of grains per labeled nucleus. Two to 4 labeled cells per high power field was the average yield in viable areas, with grain counts of 4 to 10 grains per labeled nucleus. Surrounding areas of necrotic tumor with pyknotic nuclei, vacuolated cytoplasm, and cellular debris were seen. Following the total 5500-rad preoperative dose of radiation, a 3- to 6-week interval was allowed prior to laryngectomy and radical neck dissection. During this time, in three of the four patients all clinical traces of tumor vanished from the larynx, while in the fourth an ulcerated area of false cord remained. Significant labeling appeared following radiotherapy and a 5-week waiting period in all four patients. The labeling occurred in widely separated tiny foci measuring ~500 to 1000 μ in diameter. Surprisingly there was abundance of labeling in these areas, as many as 10 to 12 labeled cells per high power field. In addition, very little histologic evidence of radiation damage appeared in these labeled foci. The heavy labeling may be the result of partial synchronization by irradiation. (BBB)

50774 EXTRAPERITONEAL SURGICAL RADIATION THERAPY FOR ADVANCED CASES OF CERVICAL CANCER. Shinagawa, S. (Hirosaki Univ., Japan). Oncology, 21: 300-9(1967).

The cure of advanced cases of cervical cancer is discussed. Neither intracavitary Ra therapy nor radical surgery can cure most cases of cervical cancer in advanced stages. A new therapeutic method for advanced cervical cancer consisting of intracavitary Ra therapy and external deep irradiation, extraperitoneal pelvic lymph node dissection, and extraperitoneal interstitial radiation is described. A high incidence of damage to bladder and/or ureter in interstitial radiation is mainly caused by a more median location of Ra or ^{60}Co sources than this method uses because procedures were done by the vaginal or the transperitoneal route and not extraperitoneally. Complications such as vesicovaginal, rectovaginal, or ureterovaginal fistula, and hemorrhage were not observed. There was no life-threatening complication with this type of extraperitoneal surgical radiation. Complications of minor degree included lymphocysts, paresis-like symptoms in the lower extremities, lymphedema of the vulva and legs, subcutaneous emphysema of the lower abdominal wall, extraperitoneal abscess, and hematoma. Their incidence was somewhat higher than in radical hysterectomy plus lymphnodectomy or lymphnodectomy alone. (BBB)

50775 BONE MARROW HISTOLOGY AND CLINICAL ASPECTS OF POLYCYTHEMIA VERA. Burkhardt, R. (Univ., Munich); Pabst, W.; Kleber, A. Arch. Klin. Med., 216: 64-104(1969). (In German).

In a histopathologic study of bone marrow in 144 patients with polycythemia vera, the effect of ^{32}P treatment on the marrow was assessed, and the relation of ^{32}P-induced changes to development of leukemia is considered. Young untreated cases were characterized by a simultaneous increase of erythropoiesis, myelopoiesis, and capillary stroma. Most cases poorly influenced by treatment developed a myeloproliferative disorder with hyperactive myelopoiesis in and outside the bone marrow: a process which explains the splenomegaly. This was usually accompanied by myelofibrosis. Treatment with ^{32}P reduced cardiac, vascular, and hemorrhagic complications; it inhibited endothelial proliferation and modified the mesenchymal reaction of bone marrow. It had no effect on the development of the myeloproliferative syndrome or on myelofibrosis. Early therapy with large intervals between later treatments by ^{32}P appeared advantageous. The occurrence of asymptomatic myelofibrosis, bone marrow aplasia, and rapidly progressing myeloproliferative disorders makes it essential to examine bone marrow prior to therapy with ^{32}P. Bone marrow histology classes polycythemia vera among the myeloproliferative syndromes. (BBB)

50776 TREATMENT OF CHRONIC LYMPHOID LEUKEMIA BY EXTRACORPOREAL IRRADIATION OF THE BLOOD. Andersen, V.; Sorensen, S. F.; Killmann, S. A. (Rigshospitalet, Copenhagen). Nouv. Rev. Franc. Hematol., 8: 709-18(Sept.-Oct. 1968). (In French).

The use of extracorporeal irradiation (ECI) with a 840-Ci ^{60}Co source to treat 11 patients with leukemia is described. Daily sessions of 6 hr were given for 4 to 5 weeks. The transit dose was 405 to 720 rad, and 2.4 to 6 blood volumes passed through the irradiation field per day. In all patients, the lymphocyte concentration in the blood decreased rapidly, and considerable regression of lymphomas occurred in all except one case. The general condition of the patients improved in half of the cases, and in five there was some indication of improvement in bone marrow function. The rates of increase in lymphocyte count and lymphatic tissue after cessation of treatment suggest that the effects of ECI may last for up to one yr. Studies of erythrocyte survival during ECI indicated some radiation-induced hemolysis, but coagulation and fibrinolysis systems were unaffected. Three patients with normal lymphocyte levels were treated with ECI. A profound and long-lasting lymphocytopenia was induced. The application of ECI in immunosuppression is also considered. (BBB)

50777 A CASE REPORT OF BRONCHOGENIC CARCINOMA IN A TWENTY-FIVE-MONTH-OLD BOY WITH RADIATION PNEUMONITIS AND DIABETES-INSIPIDUS-LIKE SYMPTOMS, AND A SURVEY OF RELATED CASES. Shibata, Shiro; Matsuura, Akio; Takayama, Naomasa; Adachi, Toshihiro; Ikeda, Sadao; Okada, Yoshio; Yamanaka, Yuichi (Kyoto Univ.). Ann. Paediat. Jap., 14: 27-45(May-June 1968). (In Japanese).

A case report of a 25-month-old boy with bronchogenic carcinoma and radioinduced lung injury is reported. Autopsy revealed a squamous cell carcinoma, partially consisting of undifferentiated cell carcinoma. From September 4, 1967 to October 14, 1967 ^{60}Co radiation therapy was given, and was very effective. The general condition of the patient improved and x-ray findings also showed improvement. Thereafter, radiation treatment was stopped at the dose of 4050 R because of side effects. After a downhill clinical course of 9½ months the patient died. Pathological findings at the autopsy revealed the tumor occupied the whole left lung, and had infiltrated to the precordial subcutaneous tissue, left diaphragm, and left ribs. Metastasis occurred to the right lung and the right adrenal. The patient had suffered from radiation pneumonitis dur-

ing ^{60}Co radiation therapy, and recovered from it after being given Dexamethasone (16 mg). The patient also showed symptoms of polyuria and polydipsia, i.e., diabetes insipidus. These signs continued until the patient's death. Maximal free water clearance by pitressin test was revealed to be 0.57 ml/min, that showed the fall of tabular reabsorption capacity of the kidney. (BBB)

50778 HYPERTHYROIDISM. Solomon, David H.; Bennett, L. Robert; Brown, Josiah; Peter, J. B.; Pollock, William F.; Richards, John B. (Univ. of California, Los Angeles). Ann. Intern. Med., 69: 1015-35(Nov. 1968).

Choice of treatment of hyperthyroidism (^{131}I, surgery, thyroid drugs) is discussed, as well as dose considerations and complications of radioiodine therapy. Every clinical center reporting on radioiodine treatment has described a remarkably high frequency of hypothyroidism. At the end of the first year after therapy, frequency of hypothyroidism in irradiated patients may be as low as 7%, but it may be higher; thereafter, there is an inexorable rise with an increment of 2 to 3%/yr. The very high frequency of hypothyroidism after radioiodine treatment constitutes a real hazard to the patient and a strong reason that surgery should be considered for most patients with hyperthyroidism. The mechanism of the effects on the thyroid of radioiodine is examined. (BBB)

50779 COMBINED TREATMENT OF CANCER OF THE ESOPHAGUS. Guernsey, James M.; Doggett III, R. L. Scotte; Mason, G. Robert; Kohatsu, Shoichi; Oberhelman, Harry A. Jr. (Stanford Univ., Palo Alto, Calif.). Amer. J. Surg., 117: 157-61(Feb. 1969).

Details of radiation treatment and ensuing radioinduced complications are reported in a study of 40 patients receiving preoperative megavoltage therapy for squamous carcinoma of the esophagus. A 6-MeV linear accelerator was used to give 6600 rad to the esophageal tumor with 6-cm margins in seven weeks. Doses of 6100 rad to the supraclavicular and/or epigastric lymph node areas were given if a positive result had been obtained on biopsy. The remaining esophagus and uninvolved epigastrium received 4400 rad. One patient failed to complete this program because of complications from a tracheoesophageal fistula. Radiation injury of the heart and pericardium resulted in the death of three patients at seven, 25, and 25 months, respectively, after the institution of radiation treatment. The fourth patient died of pulmonary insufficiency at nine months. Only three patients survive to date and are free of disease. These results with intensive preoperative radiation therapy and total esophagectomy are not significantly different from the results obtained from the use of either modality alone. The incidence of radiation complications was excessive, even though the primary tumor was eradicated in seven of 23 patients. The effects of radiation were most marked in the lungs, heart, and left lobe of the liver, that were included in the epigastric field of irradiation. The liver injury did not contribute to the morbidity in these patients. (BBB)

50780 REPORT ON A RADIUM SAFE AND LEAK TESTING SYSTEM. Morgan, Jack M.; Nunnally, James E. (Fort Worth Radiation Center, Texas. Univ. of Texas Southwestern Medical School, Dallas). Radiology, 92: 161(Jan. 1969).

A radium safe was constructed, using standard lead bricks stacked together with troughs dug in four of the bricks and fitted with plastic trays. The safe was surrounded by $\frac{1}{8}$-in. steel plate and the steel door was fitted with a rubber gasket. The outside surface was an aluminum shell. The safe was seated on a dolly so the 1,200-lb unit could be moved. A small hole was drilled in the top of the safe through the aluminum and steel coverings and fitted with tubes to allow routine testing for leaks from radium needles stored in the safe. (C.H.)

50781 STANDARDIZATION OF X-RAY GENERATORS. Gilbertson, J. D.; Fingerhut, A. G. (Harbor General Hospital, Torrance, Calif.). Radiology, 92: 165-6(Jan. 1969).

A relatively simple method was devised which, when applied to x-ray machines, revealed voltage errors as large as 90% in the 20 to 50 low kVp range and smaller errors in the tube current (mA). The technic described consists of a high-precision bleeder tank to measure the kilovoltage peak, a special high-voltage milliampere probe to measure the tube current (mA), and a high-voltage ampere probe to measure the filament current. The inherent filtration of the tube and collimator system as given by the manufacturer was checked and found to be accurate in all cases tested. The resultant flux was measured in the usual way by using a properly calibrated R meter. A high-voltage bleeder tank was constructed and connected to an oscilloscope to measure the kilovoltage peak. The tank/scope combination was calibrated with a high voltage dc power supply. A precalibrated ac power supply was used to check the tank/scope calibration. The bleeder tank was calibrated to sample accurately 1/2000 the voltage from the high-tension side of the transformer. Two special, current-measuring, high-voltage probes were constructed to measure directly the high-tension secondary current (mA) and the filament current through the x-ray tube. The use of this system revealed startling differences among machines. This system makes it possible to calibrate accurately the high voltage, milliamperage, and filament current on an x-ray generator. It will also permit the production of uniform quality and quantity radiations if the same technical factors are used, including total filtration, distance, and the like, from machine to machine within any department. (auth)

50782 TREND OF TOTAL AND LOCAL ACTIVITY IN PATIENTS SUBJECTED TO INTRALYMPHATIC RADIOTHERAPY. de Vecchi, Alberto; Bertoli, Maria Antonia; Fava, Giannino; Hliniakowa, Irena (Institut Nazionale per lo Studio e la Cura dei Tumori, Milan). Tumori, 54: 221-36(May-June 1968). (In Italian).

Determinations were made of the dose received by various organs of patients subjected to intralymphatic radiotherapy with ^{131}I-Lipiodol. For this purpose external counting techniques were devised for determining the effective half-life. Systematic checks were carried out on nine patients with a Nukab scanner by means of sectorial counts, whole-body scanning, and body profiles. By measuring the areas of successive profiles in the same patient, the effective half-life of the radioactive substance in the different body sections could be exactly determined. No shifting of the medium from the abdominal to the thoracic region by direct lymphatic route could be detected from the first day after lymphography until almost total decay of ^{131}I. The trend of radioactivity accumulation in the lung was studied during injection and during the first few hours after lymphography. Some hypotheses as to the trend activity in various body regions and the possible metabolic routes of the medium in the body are advanced. (BBB)

50783 TREATMENT OF CARCINOMA OF CERVIX, STAGES III AND IV, USING COBALT THERAPY AND A HYPERBARIC OXYGEN CHAMBER. Roulston, T. M. (Univ. of Manitoba, Winnipeg, Can.); Johnson, R. J. R. J. Obstet. Gynaecol. Brit. Commonwealth, 75: 1279-80(Dec. 1968).

A pilot study of the treatment of 25 patients with Stage III and IV carcinoma of the cervix by ^{60}Co therapy administered in fractionated doses to reach 6000 rad in 6 weeks was undertaken, the patients being in a hyperbaric oxygen chamber at 30 psi pressure during therapy. Anterior and posterior fields were used. In obese patients, skin reactions were increased with anterior and posterior opposed fields. Most patients received a minimum tumor dose of 5750 rad in 6 weeks (less than 3550 rad is normally administered to the neck of the femur). In two patients therapy was not fully completed. Interruption of therapy of one day's duration or more was necessary in 10% of patients because of bowel symptoms. In the control series this figure was 45%. Results of this pilot study showed that the hyperbaric oxygen chamber combined with ^{60}Co therapy provides a satisfactory method, and plans are being made to use ^{60}Co therapy and hyperbaric oxygen, with or without local ^{137}Cs or Ra. (BBB)

50784 TREATMENT OF CANCER OF THE TONGUE. Morita, Kazuo; Sato, Tadashi (Sapporo Medical Coll.). Nippon Igaku Hoshasen Gakkai Zasshi, 28: 1497-1505(Feb. 1969). (In Japanese).

A review was made on 94 patients with cancer of the tongue treated from January 1952 to March 1965. Eighty-one out of 94 were primary cases that were clinically classified by the TNM system. T was designated as follows: T_1; Tumors of 2 cm or less in their greatest dimension. T_2; Tumors of more than 2 cm but not more than 4 cm in their greatest dimension. T_3; Tumors of more than 4 cm in their greatest dimension or with a slight extension to the floor of the mouth. T_4; Tumors with marked involvement of the floor of the mouth or with invasion of the gum, soft palate or epiglottis. N was classified in accordance with the original TNM system. According to the above classification, 13 cases were in Stage I (T_1N_a), 20 in Stage II (T_2N_a), 45 in Stage III (T_3N_a, $T_{1-3}N_{bc}$), and 3 in Stage IV (T_4,TM). There were 13 secondary cases. Both primary lesions and regional lymph nodes were treated with surgical, radiological or combined methods. The radiation treatment of the primary lesions was confined largely to ^{60}Co needle implantation with the minimum tumor doses ranging 4000 R to 6400 R over a period of 40 to 300 hours. Twenty-one cases receiving surgery of the primary lesions were in Stages T_1 and T_2. The cure rate of the primary lesion by surgery was 47.6%, while that of the irradiated group including T_1 to T_4 was 56.7%. In most cases with or without regional lymph node metastases, the external irradiations—orthovoltage x-ray or telecobalt therapy—were administered to the homolateral regional lymph node areas following treatment of the primary lesions, but 42.9% of the N_a group developed regional lymph node metastases after the external irradiation—60% in x-ray irradiated group, 35.0% in

telecobalt therapy group. No relation was observed between the development of metastases and the doses. The 5-year survival rates corrected for expectation of life by Berkson–Gage's method (cumulative survival rates) were 33.6% ± 6.28 for primary cases with radiation alone, 100% ± 0 in Stage I, 40.4% ± 13.7 in Stage II, 24.7% ± 7.15 in Stage III, 0% in Stage IV. excluding an earlier unsuccessful period, the 5-year cumulative survival rate for the period from April 1956 to March 1965 was 38.1% ± 6.91. The 5-year cumulative survival rate of primary cases subjected to surgery was 54.4% ± 9.92, but six recurrences after surgical removal of the primary lesions were treated with cobalt needle implantation. Two of the six are alive and well for more than 5 years. The 5-year crude survival rate of 14 cases observed for 5 or more years that experienced no recurrences or metastases within a year following the treatment was 92.9%, while in 36 cases developing recurrences or metastases within a year, the 5-year crude survival rate was 8.33%. In secondary cases, the 5-year cumulative survival rate calculated from the first treatment was 17.3% ± 10.0. (auth)

50785 FRACTURE OF THE RIBS FOLLOWING RADIATION THERAPY FOR CANCER OF THE BREAST. Watanabe, Katsushi; Takeshita, Toshikazu (Kyushu Univ., Fukuoka). Nippon Igaku Hoshasen Gakkai Zasshi, 28: 1479-86(Feb. 1969). (In Japanese).

The comparison of x- and ^{60}Co γ-radioinduced rib fractures has seldom been made. During the years 1955 through 1966, 400 patients with cancer of the breast were treated postoperatively with x ray or ^{60}Co γ ray in the department of Radiology at Kyuhu University. Two hundred sixty-three cases were followed with serial chest examination over a period of more than six months after radiotherapy. An evaluation of the radioinduced rib fractures in these patients is presented. One hundred fourteen of 263 patients had received irradiation with x rays and 149 with ^{60}Co γ rays. The x-ray treatment consisted of vertical direct irradiation to the clavicular, axillary region, and anterior chest wall with a dose of 3,000 rads and three or four field sizes of 10 × 10 or 8 × 8 cm. For irradiation with ^{60}Co γ rays, the anterior chest wall, including the parasternal lymph nodes was irradiated tangentially with a dose of 4,000 rads, and the clavicular and axillary region were irradiated perpendicularly with a dose of 4,000 or 5,000 rads. The following results were obtained. In the 263 cases, rib fractures were observed in twenty seven patients (27/263 = 10.3%). The incidence of rib fractures in the group treated with x ray was 8.8%, and 11.5% in the group treated with ^{60}Co γ rays. The average time of appearance of rib fractures was 8.0 months after x-ray treatment and 9.7 months after ^{60}Co treatment. Rib fractures were observed at 16 sites in 10 patients given x-ray treatment and at 25 sites in 17 patients given ^{60}Co treatment. It was very significant that the second rib fractures were localized at the midclavicular line of the anterior chest wall, and at the third rib and the fourth rib they were situated more laterally. There was a close relation between radiation pneumonitis and rib fracture. Twenty-four of 27 patients with rib fractures had pulmonary abnormality as well. Co-existence of rib fractures and pulmonary abnormality was observed in 80% of the group treated with x rays, and 97% of the group treated with ^{60}Co γ rays. It was confirmed that rib fractures occurred very rarely without pulmonary abnormality. All of the patients with rib fractures received irradiation over 4,000 rads to the area of the fractures. It seems that rib fractures following radiotherapy depend primarily on the absorbed dose in the ribs and not on the interval and quality of the radiation. (auth) (TSS)

50786 TOLERANCE TO STAINLESS STEEL PROSTHESES IN PATIENTS AFTER POSTRADIATION HEMIMANDIBULECTOMY. Gaskins, James A.; Ertugrul, Gultekin; Rush, Benjamin F. Jr. (Univ. of Kentucky, Lexington). Amer. J. Surg., 117: 375-6(Mar. 1969).

Stainless steel splints were inserted into the mandible after irradiation for oral cancer to prevent postirradiation collapse of the mandible. Twenty-one partial mandibular resections were performed in patients receiving a tumor dose of 5000 to 6000 rad of ^{60}Co γ rays, the course of radiation ending four to six weeks prior to operation. Four patients required removal of the entire hemimandible, 15 removal of the entire horizontal ramus, and two resection of the anterior portion of the mandible with preservation of some portion of the proximal mandible on both sides. The duration of time from radiation therapy to operation averaged seven weeks, ranging from four to 10 weeks with the exception of three patients who were operated upon 39 to 140 weeks postirradiation. A simple No. 2 Steinmann pin, cut to the appropriate size, was fixed into the bone by slipping it down the marrow cavity both proximal and distal to the point of resection. This stainless steel prosthesis was implanted in the tissues to stabilize the remaining mandible. Although 38% of the prostheses required removal in one to three months, all of the pins remained in place long enough to accomplish their function of improving the position and function of the remaining bone. It is concluded that preoperative irradiation is not a contraindication to this technic. (BBB)

50787 EXPERIENCES WITH GAMMA TELETHERAPY OF CARCINOMA OF THE NASOPHARYNX AND PARANASAL SINUSES. Halama, J. (Staedtische Krankenanstalten, Essen). HNO, 15: 193-6(July 1967). (In German).

Irradiation doses measured when ^{60}Co or Ra beads or ^{137}Cs teletherapy irradiation were used for treatment of carcinomas of the nasopharynx and paranasal sinuses are discussed. Previously, the use of plastocobalt was discontinued because of its unfavorable radiation protection characteristics. It was found that adjacent healthy tissue would be more protected if the dose was administered to anterior and lateral irradiation fields so that the dose fell sharply. Lateral portions of the facial skull received dose maxima of 120% if the nasopharynx was irradiated laterally with inadequate doses, even though the center of the tumor received a 103% dose. It was observed that if two wedge-shaped close-up filters were used to shield the orbit, and were placed with the wedges to the side, then the areas adjacent to the tumor were well shielded and it was possible to irradiate the entire nasopharyngeal region with 152% of the dose. (BBB)

50788 THE TREATMENT OF RETINOBLASTOMAS WITH A ^{60}Co APPLICATOR. Tengroth, B.; Rosengren, B. H. O. (Univ. of Gothenburg, Sweden). Acta Ophthalmol., 47: 44-54(1969).

An improved ^{60}Co applicator for irradiation of retinoblastomas, which allows more precise irradiation of the tumor and protection of healthy tissue, is described. Irradiation injury of the eye during the treatment of 10 cases is reported. The device described is in the form of a silver ring which can be sutured to the episclera. Attached to this ring is a malleable arm, the distal end of which is threaded to receive the platinum-covered 3.5-mCi ^{60}Co applicator. It required 34 hr to administer a single dose of 10,000 to 13,000 rad to a depth of 1 mm. The depth-dose values and isodose-lines are presented. When large tumor masses were treated, reactions in the adjacent parts of the retina were seen. A few weeks after the application, edema in the retina was found. The tumor tissue deteriorated and could be observed as white patches in the vitreous body. After a few months, white calcium-like deposits were seen in the tumor area in combination with pigmentation of the retina and formation of telangiectases. Hemorrhages were observed in four cases. In one case, in which external x-ray treatment and five ^{60}Co applications were administered, and in another case with six applications, varicose vessels were found and new hemorrhages are expected, with poor vision as a result. In the last case, a phthisis bulbae developed. The advantage of the described method using a local ^{60}Co applicator over external irradiation of the whole eye is that only the tumor area of the retina is irradiated and destroyed while the rest of the retina is more or less free from irradiation damage. (BBB)

50789 THE ^{192}Ir SHORT-ACTING CONTACT IRRADIATION OF MALIGNANT TUMORS OF THE EAR, NOSE, AND THROAT REGION. Koburg, E. Arch. Klin. Exp. Ohren., Nasen-, Kehlkopfheilk., 191: 696-9(1968). (In German).

Irradiation characteristics, applications, and safety features of a ^{192}Ir source encased in a U housing were described and discussed. By using a source of 40 Ci a dose rate of 1200 R/min was obtained at a distance in tissue of 2 cm from the source center. At 4 mm distance the dose rate was 10,000 R/min. The energy spectrum of ^{192}Ir was similar to Ra, but the dose rate fell off more steeply with distance. As a radiation protection measure the medical personnel left the area around the source during irradiation of the patient. Instead of this the patient's head could be shielded with Pb. The advantages of using ^{192}Ir instead of Ra for irradiation of the larynx was that no surgical procedures were necessary, no cartilage window was needed, and there was no irradiation of the physician or other medical personnel. The healthy cartilage and other portions of the larynx could be protected by a suitable collimator. The possibility of delayed irradiation injuries caused by excessive ^{192}Ir dosage was not studied, but it was concluded that they would be similar to injuries caused by overdosing with Ra. (BBB)

50790 COMPLICATIONS FOLLOWING EYE TREATMENT WITH ^{90}Sr APPLICATOR. Linner, Erik (Univ. of Umea, Sweden); Rosengren, Bengt. Acta Ophthalmol., 47: 202-7(1969).

Prevention of cataract formation and its development when it did occur, in the course of treatment of benign and malignant diseases of the eye with a ^{90}Sr/^{90}Y β applicator, are described. Of the 22 patients, 15 received irradiation to a single field per eye, four towards two fields in the same eye, two towards three fields, and one towards five fields in the same eye. The daily dose per field ranged from about 1000 rad up to 2000 rad and the total dose from 3000 rad up to a maximum of around 18,000 rad. On account of overlapping, the maximum total dose administered to the patient with five fields treated in the same eye was about 30,000 rad. Irradiation had beneficial effects on the symptoms in 14 cases; six of

these patients were completely cured. The patient receiving irradiation to five fields around half the limbic circumference developed cataract. Neither cataract nor elevated intraocular pressure supervened in the other patients. When the field to be irradiated with a $^{90}Sr/^{90}Y$ applicator is situated over the corneal limbus, it is impossible to avoid some stray irradiation of the lens, particularly its equator. If the distance to the lens is 3 mm, the equator of the lens will receive about 14% of the surface dose; and at a distance of 2.5 mm the dose at the chamber angle can attain 18%. A dose of 4000 rad to the surface could give 500 rad to the lens equator and hence entail a risk of cataract. In treatment of single fields, six cases received as much as 10,000 to 18,000 rad without cataract or elevated intraocular pressure yet having developed. The radiation dose should be reduced substantially when neighboring fields are treated and there is risk of overlap. If the treated region comprises half or more of the circumference at the limbus, a further reduction is advisable, the dose then preferably not exceeding 3000 to 4000 rad per field. With very soft radiation it is usual to ignore the volume dose, but in a sensitive tissue like the lens the volume dose in a geometrically small region can become important, and then the relative volume dose with $^{90}Sr/^{90}Y$ β irradiation may readily acquire cataractogenic significance. (BBB)

50791 RADIATION ENTEROCOLITIS: A CASE REPORT. Heffernon, Elmer W.; Memik, Faruk (Lahey Clinic Foundation, Boston). Amer. J. Gastroenterol., 51: 329-34(Apr. 1969).

The case history is reported of a 74-yr-old woman in whom radiation enteritis and proctitis developed 30 yr after Rn seeds were implanted for the treatment of carcinoma of the cervix uteri. A review of the literature revealed that such late complications of radiation therapy occasionally occur. In the patient described a barium enema radiogram study showed narrowing in the sigmoid colon that was thought to be a granulomatous change secondary to radiation. An exploratory laparotomy revealed thickening of the entire small and most of the large intestine, and narrowing and rigidity of the sigmoid colon and rectum. A loop sigmoid colostomy was performed. The small and large intestinal changes were evidently the result of radiation fibrosis and enterocolitis. Early cellular pathologic changes in the gastrointestinal tract caused by radiation consist of coagulation of chromatin, disintegration of the nucleus, cell vacuolation, and cell necrosis. The epithelium at first shows a disturbance in mucosal pattern, with flattening and swelling of the nuclei. This degeneration is followed by necrosis of the epithelium. Because of hyaline degeneration and endothelial changes in the blood vessels, endarteritis and obliterative endophlebitis take place and result in ulceration and perhaps perforation. The healing process promotes fibrosis, scarring, stenosis, stricture formation, and obstruction. Early radiation injury is more easily recognized than late complications. In most cases, late complications can mimic recurrent neoplastic disease and thus mistakenly result in further irradiation of the patient with further injury to the intestine. (BBB)

50792 PROLONGATION OF THE SURVIVAL TIME OF THE CORPUS LUTEUM. Rivera, Amelia; Sherman, Alfred I. (Washington Univ., St. Louis). Amer. J. Obstet. Gynecol., 103: 986-93 (Apr. 1, 1969).

Prolongation of corpora lutea after irradiation is described. From histologic appearance the corpora lutea were more active and in a better state of preservation than would be expected from their expected date of formation. There were 23 cases that presented identical findings. The patients were all between 24 and 42 yr of age. They all were treated for carcinoma of the cervix Stage I or IIA, and all received the first Ra implant between 12 and 19 days after their last menstrual period. Subsequently they received a parametrical injection of colloidal radiogold and were subjected to a Wertheim hysterectomy and lymphadenectomy between 43 and 84 days after their last normal menstrual period. In each instance the ovaries appeared atrophic with virtually no developing follicles except that in each case there was a corpus luteum present in one of the two ovaries that appeared functional. Patients who received radiation from 4000 to 5000 mg/hr of Ra by uterine tandem and vaginal ovoids received 800 to 1000 R γ to the ovaries and the endometrium may have received 8000 to 10,000 R. This amount of radiation to the ovaries generally is sufficient for sterilization. In addition, irradiation of the endometrium will completely destroy it or render it functionless. The dose of radiation was of sufficient intensity to destroy all the ova and follicles in the ovary. However, because of the relative radioresistance of the functional corpora lutea they escaped destruction. As a consequence of the ovarian destruction the pituitary responded normally by releasing large amounts of gonadotropins, both FSH and LH. Therefore, pituitary gonadotropins were probably responsible for the continuous stimulation of the corpus luteum. The irradiated ovary in the absence of follicles was not capable of producing enough estrogens to suppress the pituitary. (BBB)

50793 COMPARATIVE RESULTS OF X-RAY AND TELECOBALT THERAPY IN THE CURE OF RHINOPHARYNGEAL NEOPLASIAS. Banfi, A.; Carnevali, G.; Felci, V. (Univ., Milan). pp 818-24 of Progress in Radiology. Vol. I. Turano, L.; Ratti, A.; Biagini, C. (eds.). New York, Excerpta Medica Foundation, 1967. (In Italian).

From 11th International Congress of Radiology, Rome. See CONF-650907-(Vol.1).

A total of 314 patients with rhinopharyngeal neoplasms, such as epithelial neoplasms, rhinopharyngiomas, and connective tissue neoplasms, were treated with x ray, telecobalt γ irradiation, or a combination of the two treatments. Comparison of the survival of the patients, median longevity, and an over-all statistical review of the therapeutic results indicated that telecobalt therapy was definitely superior by a factor of about two for the treatment of rhinopharyngeal neoplasms that were nonsarcomatous. However, telecobalt therapy was not advantageous for treatment of sarcomatous neoplasms. Telecobalt therapy was effective in treatment of regional adenopathies, because higher doses which were well tolerated could be given. (BBB)

50794 PREOPERATIVE IRRADIATION FOR NECK DISSECTION. Catlin, Daniel; Strong, Elliot W. (Memorial Center, New York). Surg. Clin. N. Amer., 47: 1131-7(Oct. 1967).

Complications arising from irradiation before surgery for metastatic cancer in the neck are reported. Both a 18-MeV Betatron and a ^{60}Co unit were used. Most patients were treated on five consecutive treatment days, receiving 400 R in air daily for a total of 2000 R through a large neck port. Such a dose produced almost no dermatitis, although mucositis and tumor regression were noted at the end of 5 days or later. Surgery was carried out as soon as possible following the last treatment, occasionally on the same day. Complications occurring among 111 patients in the irradiated group and in 164 patients undergoing surgery only were as follows: total number of complications 46 (41%), 59 (36%); pharyngeal fistula 12, 28; carotid rupture 2, 1; and chyle fistula 2, 3. The incidence of complications was not significantly different in the two groups. It was found that 89% of the cervical recurrences in the control group and 80% of those in the irradiated group occurred within the first 12 months following operation. The irradiated patients had a slightly higher incidence of lymph node metastases and thus constituted a group with somewhat more advanced cancers. Despite this disadvantage, the local recurrence rate in the necks of patients with positive nodes was 19% less than that of the unirradiated group. This result is evidence that preoperative irradiation may have damaged cancer cells that were left behind at operation. It is concluded that preoperative irradiation may effectively and significantly decrease the number of postoperative cervical recurrence of cancer. (BBB)

50795 CARCINOMA OF THE THYROID GLAND: AN ACCOUNT OF 116 OPERATED CASES. Bergfelt, G.; Engstroem, H.; Hedberg, K.; Kock, N. G.; Rosengren, B. (Sahlgrenska Sjukhuset, Gothenburg, Sweden). Acta Chir. Scand., 135: 127-32(1969).

The effects of external and internal radiotherapy for thyroid cancer and the improved results of radiotherapy as compared to surgery are reported. Postoperative radiation treatment was given to 34 of the 49 patients. In 23, external x irradiation of conventional quality or Deca-Curie irradiation was given to a tumor dose exceeding 3000 R; four patients received about 3000 R, and two less than 1000 R. In five patients the tumor regions could not be covered by external fields, and they were treated with about 100 mCi ^{131}I. For the patients with highly differentiated carcinoma the 7-yr survival was 32 of 38 (84%) in the irradiated group and 26 of 29 (90%) in the nonirradiated group, while the corresponding figures for the patients with moderately, slightly or undifferentiated carcinoma were 13 of 34 (38%) in the irradiated and three of 15 (20%) in the nonirradiated group. (BBB)

50796 RADIOISOTOPES IN BRACHYCURIETHERAPY. Pierquin, B. (Institut G. Roussy, Villejuif, France). Acta Chir. Belg., Suppl. 1, 198-206(1969). (In French).

Use of ^{137}Cs and ^{192}Ir in the form of needles or wires for interstitial treatment of tumors is described. Shielding is relatively convenient with ^{192}Ir because of its low γ energy, and the isotope is contained in thin Pt tubes. Daily doses of 1000 to 1500 rad can be given for total doses of 4000 rad, that can be supplemented with doses of up to 4500 rad of teleradiotherapy. Cesium-137 is generally used in the form of grains of about 30 mCi enclosed in stainless steel. These sources are most useful for treatment of massive facial cancers, cancers of the epiglottis and hypopharynx, of the uterus and bladder, and of nonoperable metastases in various sites. Techniques that reduce irradiation doses to normal tissue and to personnel are described, and dosimetric aspects are also considered. (BBB)

50797 METHOD OF TREATMENT OF MALIGNANT OSTEONCUS, WITH SPECIAL REFERENCE TO COMBINED TREATMENT WITH RADIOTHERAPY. Itami, Yasundo; Akamatsu, Noriya (Jikei Univ., Tokyo). Seikei Geka, 20: 814-26(May 1969). (In Japanese).

Methods used for the diagnosis and early treatment of metastatic and primary malignant neoplasms of bones in the extremities are described. Strontium-85 scanning is used for localization of the lesions. The treatment includes local endoxan perfusion (50 to 100 mg/day), large doses (up to 10,000 R) of local γ irradiation, and amputation of the limb when indicated. Roentgenological and histological examinations showed that this course of treatment gave beneficial results for primary lesions, but had only limited effects on metastatic lesions. (NSA of Japan) (TSS)

50798 STUDIES ON THE CORRELATION BETWEEN RADIOLOGICAL PATTERN OF THE BRONCHIAL CARCINOMA AND A DECREASE OF SIZE OF THE TUMOR AFTER IRRADIATION. Kujawska, Janina; Guzecki, Andrzej; Kopera, Zygmunt (Inst. of Oncology, Krakow). Nowotwory, 19: 99-103(Apr.-June 1969). (In Polish).

X-ray films of the chest made before x-radiotherapy were compared with the control ones made 8 to 13 weeks after completions of the x-ray therapy in the group of 168 patients with pulmonary carcinoma, treated in the Oncological Institute in Cracov during 1959 to 1966. A decrease of shadowing caused by the neoplastic process was observed in 57% of the patients. The highest percentage of radiological improvements was obtained in cases of nonadvanced forms, that is, in the patients with peripheral tumor without broadening of the shade of the hilus. In the group of advanced lesions good prognoses were noted in cases with infiltrations of upper lobe. (auth)

50799 SARCOMA-LIKE STRUCTURE MODIFICATION OF A LARYNGEAL CARCINOMA TAKEN TO BE A SOMATIC-STOCHASTIC RADIATION EFFECT. Minnigerode, B.; Haubrich, J. (Univ., Goettingen, Ger.). Z. Laryngol., Rhinol., Otol., 46: 695-700(Sept. 1967). (In German).

After x irradiation treatment with a dose of 2000 R and Ra treatment with 10,800 R for laryngeal squamous cell carcinoma, a sarcoma-type laryngeal tumor was observed. The possibility of adverse effects of irradiation resulting from uncontrolled exposures or excessive time intervals between the two treatments was discussed. It was stressed that well-differentiated true epithelial blastomas and differentiated connective tissue tumors could undergo histological changes so that the original tumor characteristics were no longer recognizable. It was concluded that changes in the surrounding tissues induced by the initial irradiation could have interfered with the blood supply and indirectly produced the changes observed. (BBB)

50800 CEREBRAL RADIOSURGERY. I. GAMMATHALAMOTOMY IN TWO CASES OF INTRACTABLE PAIN. Leksell, Lars (Karolinska Sjukhuset, Stockholm). Acta Chir. Scand., 134: 585-9(1968).

Macro- and microscopic studies were made of the brain in 2 cases receiving localized ^{60}Co irradiation of the thalamus. Both patients, with intractable pain from metastatic cancer were treated through the intact skull, by means of stereotaxically directed narrow beams of γ radiation. The stereotaxic technique and the use of the ^{60}Co unit are described. In one case a unilateral thalamotomy was performed. Considerable relief of pain on the side opposite the lesion was obtained although centralized pain persisted. The patient died 10 weeks later from widespread metastases. Examination of the brain showed a well-defined lesion at the precalculated site in the center median area, 11 × 8 × 6 mm in size. The lesion consisted mainly of severe necrosis with few distinguishable cellular components. Necrosis was more intense in a narrow zone at the periphery of the lesion. There was a narrow region of astrocytic gliosis, about 0.3 mm thick, surrounding the lesion. Beyond this gliosis the brain parenchyma had a normal appearance. The blood vessels in the center of the lesion were thrombotic and had necrotic walls while at the periphery of the lesion the vessel walls were somewhat fibrotic but their lumen remained patent. The second patient had a bilateral thalamotomy in two stages and eventually become completely free of pain. The lesions had the same characteristics as in the first case and were sharply demarcated from the normal brain tissue. The results show that 3 × 5 mm ^{60}Co γ radiation beams giving doses of ~25 krad are effective for relief of pain when used in the described technique. (BBB)

50801 INDICATIONS AND LIMITS OF RADIOTHERAPY WITH ELECTRONS. Belletti, Sergio; Magno, Lorenzo. Radiaz. Alta Energ., 8: 3-13(Jan. 1969). (In Italian).

The RBE of electrons, which is difficult to evaluate, but can be assumed to be a few percent lower than unity, does not warrant any expectation, with equal doses, of clinical results, in the field of oncology, different from those of photonic radiotherapy. The physical-geometric properties of electron beams make electronic radiotherapy very useful whenever the tumor volume lies between the skin and a depth not exceeding 6 to 7 centimeters. In any case the existence, within the tumor volume, of inhomogeneities must be taken into consideration and requires, if possible, direct dosimetric measurements. The utilization of electron beams for the irradiation of deep tumors involves technical and dosimetric problems and cannot be supported by serious biological or clinical arguments. (auth)

50802 SOME RECENT STUDIES IN RADIOTHERAPEUTICS. Mitchell, J. S. (Addenbrooke's Hospital, Cambridge, Eng.). J. Obstet. Gynaecol. Brit. Commonwealth, 75: 1268-74(Dec. 1968).

Macromolecular lesions produced by radiations, effects of radiosensitizers, and new radioactive drugs used in therapy are reviewed. Radiation lesions of extracellular macromolecules in the matrix of connective tissues appear to be due to depolymerization and degradation of mucopolysaccharides (glycosaminoglycans), including hyaluronic acid. Studies of the quantitative aspects of the radiosensitivity of mammalian cells, made possible by the development of methods of growing single cells in vitro to form discrete colonies, are discussed. Evidently the radiosensitive target structure is a macromolecule of DNA of molecular weight in the region of 10^{10} to 10^{11} daltons. After lymphoma cells have received a dose of 1000 R, the molecular weight of their DNA is reduced to 2×10^9 (double stranded). With increasing doses of radiation, the molecular weight falls further and the reciprocal of the molecular weight is proportional to the radiation dose. Extrapolation to zero dose indicates that the molecular weight of the DNA in the unirradiated lymphoma cell is greater than 10^{10}. The conclusion that DNA, or part of the DNA, is the principal target for the delayed killing of cells by ionizing radiations, is supported by the finding that incorporation of the thymidine analogues, 5-bromo- and 5-iododeoxyuridine into the DNA of human and other mammalian cells in culture before x irradiation produces radiosensitization. Examples of such compounds shown to act as radiosensitizers under anoxic conditions mainly by studies of the survival-dose curves for the bacterium Serratia marcescens include diacetyl, benzophenone, N-ethylmaleimide, indantrione, and 2-methyl-1,4-naphthaquinone, that is often referred to as menadione. The most reliable radiotherapeutic drug so far used is TRK 219, or 2-methyl-6,7-dititio-1,4-naphthaquinol bis (disodium phosphate). It incorporates two firmly bound tritium atoms per molecule with a specific activity of 58.2 Ci per millimole and containing 1 Ci in 7.32 mg of compound. Clinical results with TRK 219 are described. (BBB)

50803 COMBINED THERAPY WITH CYTOSTATICS AND IONIZING RADIATION OF MALIGNANT TUMOR DISEASES. Schneider, R. (Univ., Marburg/Lahn, Ger.). Med. Klin. (Munich), 62: 1317-21(Aug. 25, 1967). (In German).

Results of combined radiation and cytostatic drug treatment of tumors in animals were discussed. Results were relatively inconclusive because of differences in the antimitotic, mutagenic, cancerogenic, and anticancerous properties of the cytostatics and the type of tumor, general condition of the organism, type and sequence of dose of ionizing radiation and cytostatic agent, and volume dose of irradiation. In general, with localized irradiation treatment and subsequent fractionated chemotherapy with small daily doses treatment results were best. Simultaneous combination of Trenimon or Natulan with x ray had an additive effect on tumor growth, and on hematopoietic and lymphoreticular tissues, but survival and recovery were not affected. These effects were closely related to optimal conditions of treatment. If relatively effective doses of irradiation were used simultaneously with very high doses of cytostatic agents, animal survival and healing rates were decreased. In clinical studies, some favorable effects were obtained by combined therapy in some cases of bronchial carcinoma, ovarian endometrial tumors, Wilms tumor, and plasmocytomas, but generally clinical results with combination therapy were inconclusive. (BBB)

Blast and Thermal Effects

Refer also to abstract 50843.

50804 HEMOGLOBIN HIROSHIMA (β^{143} HISTIDINE → ASPARTIC ACID): A NEWLY IDENTIFIED FAST-MOVING BETA-CHAIN VARIANT ASSOCIATED WITH INCREASED OXYGEN AFFINITY AND COMPENSATORY ERYTHREMIA. Hamilton, Howard B.; Iuchi, Iwao; Miyaji, Takaoki; Shibata, Susumu (Atomic Bomb Casualty Commission, Hiroshima). J. Clin. Invest., 48: 525-35 (Mar. 1969).

An abnormal hemoglobin, named Hb Hiroshima, was one of two

fast-moving β-chain variants discovered during a systematic survey for hemoglobinopathies among 9262 patients who visited the outpatient clinic of the Atomic Bomb Casualty Commission in Hiroshima, Japan between June 1963 and November 1965. The other abnormal hemoglobin was Hb Hijiyama. The patients were participants in the ABCC Adult Health Study and In Utero Study, long-term investigations of the after effects of exposure to ionizing radiation. Neither the patient, a 44-yr-old housewife, nor any of her relatives were exposed to the atomic bomb in Hiroshima in 1945. Hemoglobin was identified in eight members of three generations in her family. The Hb Hiroshima constituted about 50% of the total hemoglobin in hemolysates from the carriers who had a mild erythremia but were otherwise apparently clinically unaffected. All preparations of Hb Hiroshima had increased affinity for oxygen, by either tonometric or oxygen electrode determinations. At pH 7.0 the oxygen pressure, P_{50}, required to half saturate an unfractionated hemolysate from a carrier was $\frac{1}{2}$ that of Hb A, and the P_{50} of a purified sample containing no Hb A was $\frac{1}{4}$ that of Hb A. The pH dependence of the oxygen equilibrium (Bohr effect) was below normal, as shown by the absolute value of the Bohr effect factor (about $\frac{1}{2}$ that of HbA in the pH range between 7.0 and 7.4). The Hill constant, n, for Hb Hiroshima between pH 7.0 and 7.4 was 2-2.4 compared to 2.8-3 for Hb A. Amino acid analysis demonstrated that the substitution was at residue 143 in the β chain, where histidine was replaced by aspartic acid. (BBB)

50805 AN EPIDEMIOLOGICAL STUDY ON LEUKEMIA IN SURVIVORS EXPOSED TO THE ATOMIC BOMB IN CHILDHOOD IN HOROSHIMA. PART 1. Shimizu, Kiyoshi (Hiroshima Univ.). Hiroshima J. Med. Sci., 17: 123-9(Sept. 1968).

In the leukemia cases in survivors of the atomic bomb who were exposed at less than nine yr of age, there were more females than males; in those exposed between ages 10 to 14 yrs, there were more males than females; while in the ages less than 14 yrs and more than 15 yrs at time of the bomb, not much difference was observed between the sexes. The majority of the leukemia cases were exposed directly to the bomb and a high frequency was seen in those exposed within 1,499 m from the hypocenter, the highest frequency being in those exposed within 999 m. Acute myelogenic leukemia tended to decrease gradually with increase in age at time of exposure, but the rate of chronic myelogenic leukemia increased prominently in proportion to increase in age at time of exposure. In the survival period less than 12 months after onset, nearly half of the leukemia cases was occupied by the 0 to 4 yr age group, while in the period more than 12 months, the 10 to 14 yr age group occupied one-half of the cases. (NSA of Japan)

50806 RESULT OF FOLLOW-UP STUDY OF ATOMIC BOMB RADIATION CATARACT IN NAGASAKI. Tokunaga, Tsugihiko (Nagasaki Univ. School of Medicine). Nippon Ganka Gakkai Zasshi, 72: 1774-81(Sept. 1968). (In Japanese).

A follow-up survey was conducted from May, 1966, to December, 1967, in Nagasaki on 150 atomic bomb survivors who had been examined ophthalmologically between July, 1953, and December, 1956. Marked progression of lenticular opacities was observed in one of two cases of severe atomic bomb radiation cataract. All mild and moderate cases of cataract showed some recovery. Various types of opacities were present in the deeper layer of the posterior cortex and the superficial layer of the posterior adult nucleus. The radiation dose assessed by the Tentative 1965 Dose of the Atomic Bomb Casualty Commission was 813 rad for cases of severe cataract, 214 to 1397 rad for cases of moderate cataract, and 87 to 917 rad for cases of mild cataract. (auth)

Radiation Effects on Animals

Refer also to abstracts 50236, 50345, 50365, 50367, 50494, 50495, 50534, 50802, 50946, and 51857.

50807 (AEC-tr-7023) RADIOBIOLOGY. Translation of Radiobiologiya, 8: No. 5, 659-771(1968). 188p. Dep. CFSTI.

Papers within the scope of NSA were abstracted from the original language and have appeared in previous issues. (C.O.)

50808 (PHS-999-RH-33, pp 5-22) RADIOSENSITIVITY OF CELLS. Whitmore, Gordon F. (Toronto Univ. (Ontario). Dept. of Medical Biophysics).

The variation in radiosensitivity of cells throughout the cell cycle is discussed and the survival curves of experiments are shown. Some experiments were carried out to show the effect of temperature on cell radiosensitivity and the phenomenon of cold protection was discussed. The involvement of RNA synthesis was investigated by addition of methotrexate and its reversing compounds after irradiation. (F.M.M.)

50809 A STUDY OF THE RELATIVE BIOLOGICAL EFFECTIVENESS FOR 35-MeV ELECTRONS WITH MAMMALIAN CELLS (100 TO 10 PERCENT DEPTH-DOSE LEVELS). Robinson, J. Eugene; Ervin, T. L. (Univ. of Maryland, Baltimore). Ann. N. Y. Acad. Sci., 161: 301-9(July 3, 1969).

From Conference on High Energy Radiation Therapy Dosimetry, New York. See CONF-670665.

Results of experiments designed to determine the RBE of 35 MeV electrons and its variation with depth below the phantom surface are presented. Cultured mammalian cells were irradiated in petri dishes to doses of 700 to 750 rads with 35 MeV electrons. Electron beam irradiations were carried out in Lucite phantoms, the depth-dose levels being obtained by interposing Lucite between the cells and the beam. X-ray beams of 300 Kvp were used for comparative irradiation of the cells. The RBE was found to be 0.87. (E.R.B.)

50810 DISCUSSION [BIOLOGICAL EFFECT OF EXTREMELY HIGH DOSE RATES]. Hall, Eric J. (Churchill Hospital, Oxford). Ann. N. Y. Acad. Sci., 161: 341-3(July 3, 1969).

From Conference on High Energy Radiation Therapy Dosimetry, New York. See CONF-670665.

The effects of high dose rates on cultured HeLa cells and Chinese hamster cells was studied. A Blumlein generator was used to produce a pulse of 2 Mv x rays of 10 nanosecond duration delivering a dose of 200 to 1,500 rads. For comparative purposes, survival curves of both cell lines were plotted following ^{60}Co γ irradiation at a dose rate of 100 rads/min. Though equally effective at lower doses, above 500 rads, the γ rays were more effective than the x rays. The phenomenon was apparent in both cell lines and was repeated in replicate experiments. (E.R.B.)

50811 IMPLICATIONS FOR ELECTRON THERAPY OF RADIOBIOLOGICAL RESEARCH WITH HEAVY PARTICLES. Bewley, D. K. (Hammersmith Hospital, London). Ann. N. Y. Acad. Sci., 161: 323-36(July 3, 1969).

From Conference on High Energy Radiation Therapy Dosimetry, New York. See CONF-670665.

Research with heavy ions covers a wide range of radiation quality and shows the trend of the variation in biological response with quality. This can then be applied to the smaller range of quality covered by fast electrons and x rays. Topics discussed in this framework are the variations of RBE with quality and dose level, spectra of LET, possible changes of RBE with depth in a tissue-equivalent medium, and the best quality to use for radiotherapy. (auth)

50812 ACTION OF ADENOSINETRIPHOSPHATE (ATP) ON THE MOVEMENT OF CYTOPLASM IN PLANT CELLS SUBJECTED TO ULTRAVIOLET IRRADIATION. Tageeva, S. V.; Dubrov, A. P. (Inst. of Biological Physics, Moscow). Dokl. Akad. Nauk SSSR, 186: 711-13(1969). (In Russian).

Onion cells (Allium) were irradiated on the object stage of a microscope from above through a system of quartz objectives. Neighboring unirradiated cells served as controls. The reaction of the irradiated cells to ATP (10^{-3} to 10^{-1} M), riboflavine (10^{-4} to 10^{-2} M), and calcium glycerophosphate (0.5 to 1.0%) was investigated. A uv dose of 1.5 to 2.0×10^6 ergs/cm^2 slowed the circulation of the cytoplasm from 7.2 to 2.5 microns/sec. Movement stopped completely at a dose of 4.0 to 5.0×10^6 ergs/cm^2. It was found that an ATP concentration of 0.1 M was optimal in starting up circulation that had stopped. Thus with a dose of 1.5 to 2.0×10^6 ergs/cm^2, circulation begins 20 to 30 seconds after addition of ATP with complete restoration in 10 to 15 min. With a dose of 4.0 to 10^6 ergs/cm^2, an increase in Brownian movement could be observed with a slight movement of separate spherosomes in 5 to 7 min after addition of ATP. Slow cytoplasm movement began in 15 min with complete restoration of movement in 35 to 40 min. Thus, ATP of exogenous origin can reactivate cytoplasm movement that was stopped by uv irradiation. Calcium glycerophosphate was also effective in restoring movement, but less so than ATP. Riboflavin had no effect on restoring cytoplasm circulation. (TTT)

50813 COMPARISON OF MITOMYCIN C AND X-RAYS FOR THE PRODUCTION OF ONE-WAY STIMULATION IN MIXED LEUCOCYTE CULTURES. Elves, M. W. (Charles Salt Research Center, Oswestry, Eng.). Nature (London), 223: 90-1(July 5, 1969).

It is stated that for use as a histocompatibility test a unidirectional mixed leucocyte reaction is desirable. In order to produce cultures in which one-way stimulation occurs, the lymphocytes of one partner must be capable of responding to an antigenic stimulus, while cells from the second partner should be immunologically unreactive but stimulatory. This second population can be produced in a number of ways, including pre-treatment with mitomycin

C or high doses of x irradiation. Studies with human volunteers are described with a view to comparing the effectiveness of these two methods, using the same samples of cells in cultures set up simultaneously. In the irradiation studies the cells were treated with 1200 R of x rays. Comparison of the effects of the two treatments on the one-way cultures indicated that the mean reaction in the UM cultures was, in general, considerably less than in the corresponding UX cultures, judged either by transformation or DNA synthesis, although this was not true of all combinations. Morphologically most of the UM cultures showed considerable evidence of cell damage, which was not seen in the UX cultures. It is concluded that many of the difficulties encountered with the mitomycin C technique are not present when x rays are incapable of proliferative response to the allogeneic cells. (UK)

50814 PRODUCTION OF THE INDUCER FOR MACROPHAGE AND GRANULOCYTE COLONIES BY LEUKEMIC CELLS. **Paran, Michael; Ichikawa, Yasuo; Sachs, Leo (Weismann Inst. of Science, Rehovoth, Israel). J. Cell. Physiol., 72: 251-4(Dec. 1968).**

Cell lines from a radioinduced myeloid, an erythroid, and two lymphoid leukemias were tested for the production of the inducer required for the formation of macrophage and granulocyte colonies. The neoplastic cells used consisted of cultures of cells from these leukemias and from a sarcoma. The myeloid line was a primitive myeloid leukemia (P1081) produced in a DBA mouse after x irradiation with three doses of 100 R. The neoplastic cells used as feeder layers were x irradiated with 2000 R. The results obtained with the feeder layers indicated that the myeloid (P1081), erythroid (CICPR), and one of the lymphoid (L1210) leukemia cell lines tested can induce the formation of M and G colonies from hematopoietic cells, but no colonies were induced by the lymphoid leukemia MDA. As with the inducer produced by other cell types, the inducer produced by the leukemic cells did not pass through a dialysis membrane. The results obtained with conditioned medium indicate that the inducer was present in conditioned medium from P1081, CICPR, and L1210, and that MDA again showed no detectable inducing activity. Although cells of the line MDA did not produce detectable inducer, these cells, like the other cell lines tested, produce a dialyzable substance that stimulated the growth of tumor cells. The inducer can be produced by erythroid and myeloid cells in an early stage of differentiation. (BBB)

50815 GENERAL DISCUSSION OF LYMPHOCYTE CIRCULATION AND EXTRACORPOREAL IRRADIATION. **Binet, J. L.; Cottier, H.; Cronkite, E. P.; (and others). Nouv. Rev. Franc. Hematol., 8: 745-58(Sept.-Oct. 1968). (In French).**

Lymphocyte circulation is discussed in terms of immunocompetent cells, circulation of lymphocytes in spleen, bone marrow, lymph nodes, thoracic duct, and in the fetus, and radioisotope methods for studying lymphocyte circulation. Extracorporeal circulation (ECI) is discussed in terms of its mode of action, technical aspects, and use in chronic lymphoid leukemia. In ECI in calves, 90% of lymphocytes in blood receiving a transit dose of 300 rad showed pyknosis. However, much larger doses (up to 1000 rad) may be required to produce a marked lymphopenia, and after these doses complete disappearance of lymphocytes, rather than merely pyknosis, may be observed. Whether short or long irradiation courses should be used is discussed. Use of ECI in leukemia patients resistant to drug treatment is proposed. (BBB)

50816 UNUSUAL MEMBRANE ALTERATIONS IN MITOCHONDRIA AFTER WHOLE-BODY X IRRADIATION. **Mukherjee, T. M.; Bradley, G. E.; Williams, A. Wynn (Otago Univ., Dunedin, N. Z.). Proc. Univ. Otago Med. Sch., 46: 77-9(Oct. 1968).**

Alterations in the membranes in mitochondria of intestinal epithelial cells seen shortly after irradiation are described in detail. Mice were killed at intervals of 30 min, 2, 4, 6, 24, and 72 hr, after 200- or 1350-R ^{60}Co irradiation. Focal alterations in the inner and outer mitochondrial membranes and the immediately adjacent matrix were observed as early as 30 min after irradiation and at this stage were seen on otherwise normal-looking mitochondria. Later, there was an associated loss of homogeneity in the mitochondrial matrix. Both inner and outer membranes were lengthened, becoming serpiginous. These lengthened portions were accommodated either by invagination into the mitochondrial matrix or by a bulging outwards into the cytoplasmic matrix. Initially the deformed membranes were like blebs within the mitochondrial matrix, but later these blebs were transformed into whorls and the clear lamina between the outer and inner mitochondrial membranes were irregular and considerably widened with complete loss of normal spatial relations. It was suggested that the mitochondrial changes may result from accumulation of excess phospholipids or lipoproteins in the mitochondria, that are known to be capable of synthesizing these substances. The significant increase of phospholipid synthesis after irradiation and the observation that excess of intracellular phospholipids or lipoproteins may appear electronmicroscopically as membranous whorls support this view. (BBB)

50817 LOSS OF INTRACELLULAR K^+ IONS FROM THE INTACT EHRLICH ASCITES CARCINOMA CELL FOLLOWING IRRADIATION WITH 15 MeV ELECTRONS AND X-RAYS. **Flemming, K.; Mehrishi, J. N.; Napier, J. A. F. (Univ. of Cambridge, Eng. Addenbrooke's Hospital, Cambridge, Eng.). Int. J. Radiat. Biol., 14: 175-86(1968).**

The effect of 15 MeV electrons and x rays from a linear accelerator on the permeability of Ehrlich–Landschütz murine ascites carcinoma cell membrane was studied in vitro by measuring the loss of potassium ions from the cells into a potassium-free medium. The cells were washed in saline (0.145 M NaCl made 10^{-4} M with respect to $NaHCO_3$; pH 7.2 ± 0.2) and saline suspensions were irradiated over the dose range 20,000 to 85,000 rads in the presence of air, excess oxygen, 2-methyl-1,4-naphthaquinol bis (disodium phosphate) [MNDP] (10^{-5}M), and 2-amino-3-methyl butane thiol [AMBT] (10^{-4}M). The experiments showed that irradiation caused a significantly greater loss of potassium from the irradiated cells compared with the control unirradiated cells, and this was more marked in the presence of MNDP and excess oxygen. The radiosensitizing effect of oxygen, MNDP, and the radioprotecting effect of AMBT were clearly demonstrated. Possible mechanisms for the radiation damage of the cell-membrane function, involving cation balance and cell-surface enzymes, are discussed. (auth)

50818 NEUROPHYSIOLOGICAL EFFECTS OF TERATOGENIC AGENTS IN ONTOGENY. **Bergstroem, R. M. (Univ. of Helsinki). Acta Neurol. Scand., 43: Suppl. 31, 37-42(1967).**

The neurophysiological effects of ionizing radiations and other teratogenic substances were considered in terms of their influence on integrated neural functions, on motor functions, and on sensory functions of the fetus. Only a few agents having morphological teratogenic effects were reported as having a specific neural action. However, many teratogens produce nonspecific morphological disturbances of the central nervous system, together with malformations of other tissues. For instance, specific brain defects can be obtained with insulin (in rabbits), trypan blue (in rats), streptomycin (in mice), toxic doses of salicylates, and by x irradiation. It is difficult to determine the mechanism by which neuroactive teratogens may disturb fetal development, and thus induce malformations and pathological processes of the nervous system. X-irradiation studies permit analysis of the most sensitive periods of fetal life to disturbances of the neural system. Such radiation studies show that the primitive neuroblasts are the most radiosensitive structures of the nervous system, and that the sensitive regions in the central nervous system alter in the same order and direction as the developmental maturation of the different parts of the system. This may hold true for most teratogenic agents, since it is known that enzymatic activity, which is likely to be disturbed, is very intense in the regions where development is in progress. Moreover, the critical periods of the myelinization of the central structures must be considered (in the human the medullation of the central nervous system begins at the 22nd week of fetal life). Radiomimetic drugs such as nitrogen mustard, triethylene melamine, and certain sulfhydryl reagents, selectively destroy neuroblasts. Agents such as aminopterin and cortisone also imitate radiation effects but are less specific. Most nonspecific morphological effects consist of various forms of hydrocephalus and exencephaly. Specific effects may include marked asymmetry of the brain, microcephaly, cell pyknosis, disturbance of the neuroblasts, or degeneration of various distinct parts of the brain. (BBB)

50819 EFFECT OF IRRADIATION AT EXTREMELY HIGH DOSE-RATES. **Oliver, R. (Churchill Hospital, Oxford). Brit. J. Radiol., 42: 231-3(Mar. 1969).**

Problems in interpreting data on the effects of extremely high dose rates of ^{60}Co γ radiation on the survival of cultured cells are discussed. (C.H.)

50820 DOSE-RESPONSE CURVES FOR AGENTS THAT IMPAIR CELL REPRODUCTIVE INTEGRITY. I. A FUNDAMENTAL DIFFERENCE BETWEEN DOSE-RESPONSE CURVES OR ANTIMETABOLITES AND THOSE FOR RADIATION AND ALKYLATING AGENTS. **Berenbaum, M. C. (St. Mary's Hospital Medical School, London). Brit. J. Cancer, 23: 426-33(June 1969).**

The effects of antimetabolites, alkylating agents, and ionizing radiation on antigen-stimulated spleen cell proliferation were compared to evaluate differences in the dose-response curves for the three classes of agents. Hemolysin-producing cells in the spleen of A2G mice were assayed 5 days after immunization with sheep red cells. The number of plaque-forming cells per spleen (expressed as a fraction of the control number) was plotted on a

logarithmic scale against dose. The scale for dose was linear for the alkylating agents aniline mustard, cyclophosphamide, and melphalan, but logarithmic for the antimetabolites methotrexate, 6-thioguanine, and 5-fluorouracil. The dose-response curves for the alkylating agents used are therefore exponential, whereas those for the antimetabolites have a hyperbolic form. The dose-response curves given by radiation are exponential. The reason for this difference may be that the interaction between a molecule of alkylating agent or an ionizing event on the one hand and a cell component on the other does not affect the probability of other, similar interactions, either simultaneous or subsequent; whereas the interaction between a molecule of antimetabolite or metabolite and an enzyme site strongly affects the probability of another such reaction. The dose-response relation for alkylating agents and ionizing radiation is therefore governed by classic target theory based on a 1-hit interaction. (BBB)

50821 DEFECTIVE PHOTOCHEMICAL REPAIR IN EPITHELIUM PREDISPOSED TO FIELD CANCERIZATION. Roth, Daniel; Sage, Harold H. (New York Univ., N. Y.). Cancer, 24: 511-19(Sept. 1969).

Capability for repairing ultraviolet radiation damage was studied in the desquamated buccal cells of 34 individuals with histories of cancer of the oral cavity and upper respiratory tract, and of 3 asymptomatic smokers. Repair was evaluated in terms of the cellular uptake of an acridine marker for thymine dimer, in response to visible light and an enzyme derived from baker's yeast possessing photoreactivating ability (cytochrome b2). A repair deficit was displayed by the tested cells regardless of disease stage, treatment, or cure. Cultured diploid human cells which had been incubated with calf thymus DNA or Simian virus 40 developed a comparable repair deficit showing both dose-relationship and specificity for the incubated DNA. It is proposed that incorporated DNA, by failing to respond adequately to repair mechanisms, may increase the cell's sensitivity to mutagenic agents. (auth)

50822 ADVANCES IN BIOLOGICAL AND MEDICAL PHYSICS. VOLUME 12. Lawrence, John H.; Gofman, John W. (eds.). New York, Academic Press, Inc., 1968. 388p. $17.50.

Included in addition to the papers of a symposium on biophysical approaches to the effects of radiation and their repair (a separate abstract for the symposium was prepared for inclusion in NSA) are sections on the following: technique and application of freeze-etching in ultrastructure research; principles and applications of the scanning electron microscope in biology and medicine; a model of the chromosome; and a systematic approach to kinetic studies of multisubstrate enzyme systems. (C.O.)

For an abstract of the individual paper see: 50823.

50823 SOME BIOPHYSICAL APPROACHES TO THE EFFECTS OF RADIATION AND THEIR REPAIR. Advan. Biol. Med. Phys., 12: 213-379(1968). (CONF-660928).

From 2nd International Biophysics Congress, Vienna, Austria.

Topics considered in the symposium include: the excited states of DNA, effects of radiation on DNA metabolism in animal tissues, mig. ation of radiation damage in DNA, cellular repair processes (bacteria, phages, and yeast), radiosensitivity in relation to the physiological state of yeast cells, photoreactivation of mutation and killing in E. coli, genes that control DNA repair and genetic recombination in E. coli, suppressors and suppressible mutations in yeast, the role of the cytoplasm in radiobiology, genetic repair phenomena and dose-rate effects in animals, and random factors in the survival curve. (C.O.)

Invertebrates

Refer also to abstracts 50355, 50377, 50382, 50399, 50427, 50963, and 50973.

50824 AUTORADIOGRAPHIC STUDY OF DNA SYNTHESIS FROM THE INCLUSION OF THYMIDINE-^{3}H DURING RESTORATION OF REGENERATIVE ABILITY IN AXOLOTL EXTREMITIES, SUPPRESSED BY X RAY IRRADIATION. Tuchkova, S. Ya. (Inst. of Biology of Development, Moscow). Dokl. Akad. Nauk SSSR, 186: 724-7(1969). (In Russian).

A total of 60 salamanders was separated into three groups: a control group with amputation of nonirradiated extremities, a second group with irradiation and amputation of extremities, and a third group with irradiation, amputation, and RNA injection. An x ray dose of 6000 R was administered to the extremity with the body being covered with lead 4 mm thick. Amputation was carried out 20 days after irradiation. Fixation of the extremity was carried out on 1, 5, 8, 12, 15, and 22 days after amputation with the introduction of 1 μCi of ^{3}H-thymidine per gram of body weight 6 hr before fixation. In the third group, fixation was delayed two months while repeated amputations were carried out to stimulate tissue regeneration. Otherwise the fixation times were the same as in the other two groups. In the control group the extremities were regenerated in 100% of the cases, while in the second group regeneration was completely suppressed. In the third group where the regenerative ability of the extremities was restored by RNA injections, the radioautographic studies show a gradual increase in DNA synthesis in tissues of mesodermal origin. (TTT)

50825 IMMUNIZATION OF RATS WITH IRRADIATED STRONGYLOIDES LARVAE. Chaia, Geraldo (Instituto Nacional de Endemias Rurais, Belo Horizonte, Brazil); Murta, Clecio Campi. Rev. Inst. Med. Trop. Sao Paulo, 9: 163-8 (May-June 1967).

The action of ^{60}Co γ irradiation on Strongyloides larvae and the vaccination of rats with these irradiated larvae were studied. Six groups of rats were subcutaneously infected with about 3300 irradiated larvae of Strongyloides (S. venezuelensis + S. ratti). The larvae were irradiated with 10, 20, 30, 40, 50, and 60 KR. Other rats were infected three times with about 10,000 larvae irradiated with 140 KR, with a 15-day interval between infections. No modification was observed in the structure of worms recovered from rats infested with larvae irradiated with 10 to 40 kR, but there was a reduction in the number of worms recovered 30 days after the infection with the irradiated larvae. The worms from larvae irradiated with 50 kR had no genital apparatus and were smaller than normal. The percentage of worms from irradiated larvae decreased as the dose of irradiation increased. The larvae withstood irradiation with 140 kR. Rats vaccinated three times with 10,000 irradiated larvae (140 kR) developed immunity to Strongyloides infection. This higher dose is recommended for immunization of rats. (BBB)

50826 EFFECT OF GAMMA RADIATION ON THE INSECTICIDAL EFFICIENCY OF MALATHION DEPOSITS ON WHEAT AND KRAFT PAPER. Cogburn, Robert R.; Mahany, Patrick G. (Agricultural Research Service, Savannah). J. Econ. Entomol., 62: 829-31(Aug. 1969).

Malathion deposits on wheat and kraft paper were irradiated with several dosage levels of γ radiation. After various periods of aging, samples were bioassayed with adults of the red flour beetle, Tribolium castaneum (Herbst). Chemical analyses were done concurrently with the bioassays. Neither the toxicity nor the chemical degradation of the malathion deposits was significantly affected by irradiation with γ doses ranging from intermediate (25 krad) to massive (4.3 mrad). (auth)

50827 THE INFLUENCE OF PULSED MICROWAVES ON OPALINA RANARUM. Makarov, P. O.; Ismailov, E. Sh. Nerv. Sist., 8: 140-3(1967). (In Russian).

Experimental studies of the influence of continuous and intermittent microwave irradiation of Opalina ranarum revealed that at certain intensities, cell death occurred after 7 min. of continuous irradiation or after 4 min. of exposure to pulsed microwaves. Data are given on the maximum and minimum effects produced by microwaves under various conditions. (R.V.J.)

Vertebrates

Refer also to abstracts 49725, 50255, 50264, 50276, 50291–50293, 50312, 50318, 50329, 50336, 50338, 50342, 50344, 50347, 50348, 50350, 50359, 50361–50363, 50366, 50370–50373, 50376, 50378–50381, 50384, 50386, 50387, 50392, 50393, 50415, 50581, 50613–50628, 50630–50639, 50647, 50803, and 50962.

50828 (AEC-tr-7024) RADIOBIOLOGY. Translation of Radiobiologiya, 9: No. 1, 1-168(1969). 223p. Dep. CFSTI.

Papers within the scope of NSA were previously abstracted from the original language and have appeared in NSA. (E.R.B.)

50829 (AEC-tr-7025) RADIOBIOLOGY. Translation of Radiobiologiya, 9: No. 2, 169-336(1969). 217p. Dep. CFSTI.

Papers within the scope of NSA were previously abstracted from the original language and have appeared in NSA. (E.R.B.)

50830 (COO-1475-5) EFFECT OF IONIZING RADIATION ON RECURRENT INHIBITION OF THE SPINAL CORD. Barnes, Charles D. (Indiana Univ., Bloomington). [1969]. Contract AT(11-1)-1475. 18p. Dep. CFSTI.

Cats were decerebrated and dorsal and ventral roots of lumbar nerves were exposed. Radiation doses of 200 to 5,000 rads were administered to the brain stem and spinal cord, and results were recorded in the form of a histogram. Early radiation changes were detected with the lowest doses. Figures are presented to show effects of acute radiation on the brainstem conditioned lumbar spinal

cord extensor and flexor monosynaptic reflexes from the gastrocnemius and common peroneal muscles. It was found that increased doses led to inhibition of the unconditioned monosynaptic even if the early effect of radiation was facilitation. The effect of the removal of the cerebellum on the histogram patterns of the animal prior to radiation showed a lack of the long latency facilitation or inhibition that was seen in noncerebellectomized animals. Effects of radiation on short and long latency responses are discussed. It is thought that much of the effect of radiation on the brainstem-cord interactions is a result of the effect on the cerebellar Purkinje cells. It is suggested that if the radiosensitivity is further verified it will provide a useful tool for studying cerebellar-brainstem-cord interactions. (H.L.W.)

50831 (COO–1669-6) STUDIES ON THE MECHANISM OF THE EFFECT OF IONIZING RADIATIONS ON THE OLFACTORY SYSTEM. Progress Report, January 1, 1969–September 1, 1969. Cooper, Gary P. (Cincinnati Univ., Ohio. Dept. of Environmental Health). Sept. 25, 1969. Contract AT(11-1)-1669. 19p. Dep. CFSTI.

The effects of x rays on the olfactory system of rats were examined in three experiments, one of which is still in progress. In one experiment the response of single olfactory bulb neurons to x rays was studied during the perfusion through the nasal cavities of gas containing various concentrations of oxygen. The results show that the response to x ray is constant for oxygen concentrations above 5 percent, while appreciable response decrement does not occur until concentrations of 2 percent or less are used. The oxygen concentration at which response decrements are first seen (about 2 percent) and the maximum response decrement occurring with 0 percent oxygen (about 30 percent of control values) closely agree with certain other experiments in which the oxygen effect has been demonstrated. It was concluded that x rays probably stimulate the olfactory system indirectly by the production of chemical agents and through reactions which are facilitated by oxygen. In another study it was found that immediate alterations in respiratory rate could be produced in anesthetized rats by x rays. Further investigations in unanesthetized animals having lesions of the olfactory bulbs or sham lesions of the cerebral cortex revealed that such effects were largely, if not entirely, a consequence of olfactory stimulation by the radiation. Thus, the arousal effect of olfactory stimulation by x rays is potent enough to produce striking and immediate changes in respiration and such changes may be used as an index of olfactory stimulation. A study now in progress is aimed at determining the relative responsiveness of rat olfactory bulb neurons to x ray, ozone, and odor (amyl acetate). Although it is still too early to draw definite conclusions, preliminary results indicate that cells responsive to x rays are also more responsive to ozone than cells which are not responsive to x ray. The data obtained thus far indicate that the radiation-produced olfactory stimulus is an oxidizing agent similar to ozone, if not ozone itself. (auth)

50832 (PHS–999-RH-33, pp 2-4) MECHANISM OF RADIATION INJURY. Totter, John R. (Division of Biology and Medicine (AEC), Washington, D. C.).

The mechanism of radiation injury to bacterial cells following absorption of uv light and the effects of ionizing radiation on higher organisms are discussed. A comparison is made of the manner in which the DNA may be affected thus leading to genetic damage. Recovery in higher animals following transplantation to replace stem cells is mentioned. (F.M.M.)

50833 (PHS–999-RH-33, pp 59-60) EFFECTS OF RADIATION ON BONE. Jee, Webster S. S. (Utah Univ., Salt Lake City. Dept. of Anatomy).

The incidence of bone neoplasms in beagle dogs following the injection of α-emitting radioisotopes is reported. Radium-226, ^{239}Pu, ^{226}Ra, and ^{228}Th produced bone cancer at dose rates 11 to 18 times those corresponding to ICRP maximum permissible body burden for radiation workers. In the case of the β-particle dose from ^{90}Sr, the ratio was found to be even greater; osteosarcomas were induced at an average dose rate of 530 times the permissible rate. RBE values relative to ^{226}Ra as 1 were as follows: ^{239}Pu = 10, ^{226}Ra = 2.5, ^{228}Th = 6, and ^{90}Sr = 0.1. The differences in RBE were related to the chemical form and behavior of the isotopes. (C.O.)

50834 (STI/PUB–219) BONE-MARROW CONSERVATION, CULTURE, AND TRANSPLANTATION. Panel Proceedings Series. Proceedings of a Panel Held in Moscow, 22–26 July 1968. (International Atomic Energy Agency, Vienna (Austria)). July 1969. 201p. (CONF-680721). IAEA: $5.00. Dep.

Separate abstracts were prepared for six papers presented at the conference. An additional 12 papers are included on various aspects of preservation and transplantation of bone marrow. (H.L.W.)

For abstracts of individual papers see: 50392, 50633, 50634, and 50880–50882.

50835 (TID–25119) RESEARCH PROPOSAL AND ANNUAL REPORT NO. 9, SEPTEMBER 1, 1968–AUGUST 31, 1969. PART B. TECHNICAL. (Florida State Univ., Tallahassee. Inst. of Molecular Biophysics). June 1, 1969. Contract AT(40-1)-2690. 51p. Dep. CFSTI.

The fundamental irradiation effects at a microscopic level on simple organic crystals are under investigation. Crystals of oxalic acid, potassium oxalate, and tartaric acid were electron-, γ-, or x-irradiated at 4.2 to 300°K, and the free radicals produced by irradiations were analyzed. A conventional high field ESR spectrometer and a zero field ESR spectrometer were constructed for use in analyzing the free radicals. The quality and intensity of discrimination to a preferred taste solution when paired with a sublethal dose of ionizing radiation were studied in rats. Rats irradiated in the presence of sucrose avoided fructose, maltose, and glucose solutions. A pronounced increase in aversion in these animals was demonstrated when the animals were irradiated in the latter part of the dark period in the day-night cycle. Dose rate threshold measurements were determined in monkeys and rats who were conditioned to suppress ongoing lever responding during exposure to x rays. It was subsequently demonstrated that this immediate x-ray detection was dependent on an intact olfactory system. Twenty three other abstracts of nonradiological, molecular research are also presented in this report. (E.R.B.)

50836 ALTERATIONS IN SERUM IRON IN GERMFREE AND CONVENTIONAL MICE AFTER WHOLE-BODY X IRRADIATION. Wilson, Raphael; Barry, Thomas A.; Bealmear, Patricia M. (Univ. of Notre Dame, Ind.). Life Sci., 8: 401-14(Apr. 15, 1969).

The hypothesis was tested that bacteria, through products that they either produce themselves or induce in the host, affect the host's normal physiology adversely after whole-body x irradiation. One effect, capillary permeability, known to be influenced by bacterial products was studied on the basis of serum iron levels. The serum iron response of germfree and conventional CFW mice to whole-body x irradiation was markedly different. The serum protein-bound iron pattern in irradiated conventional mice was characterized by an initial hyperferremia, followed closely by a more sustained hypoferremia, and lastly by a gradual return to normal limits. The extent and duration of each phasic response was dose dependent. In direct contrast to the conventional animal picture was the serum bound iron pattern noted in irradiated germfree mice that was one of sustained hyperferremia. The presence of a microflora in the conventional animal, or the absence of it in the germfree animal, is evidently responsible for the different response to irradiation. That exposure to irradiation affected the hematopoietic tissue of both groups in a similar manner was suggested by the identical decrease in hematocrit values. (BBB)

50837 SITUS INVERSUS OF THE NEWT (TRITURUS ALPESTRIS) AFTER UV IRRADIATION OF GASTRULAS. von Kraft, Arne (Heiligenberg Institut, Ger.). Arch Entwicklungsmech. Organ., 161: 351-74(Nov. 15, 1968). (In German).

Ultraviolet light from a high-pressure Hg lamp was used to irradiate gastrulas at Harrison stage 9 to 13 and neurulas at stage 15 to 17, using various doses and exposing various body regions. Bilateral irradiation led to a markedly higher mortality than unilateral irradiation. Gastrulas showed better regulation capability than neurulas. The frequency of alterations of the situs (irregularities, partial and total inversion), lethality, and rate of malformations were dose dependent. Irradiation of the right side of early gastrulas (Harrison stage 9 to 11 a) led to a higher frequency of inversions than irradiation of the left or animal side. The frequency of inversions of later gastrulas (stage 12 to 13) was the same after right- and left-side irradiation. The expression of inversions was different after irradiation of gastrulas and of neurulas. The problem of physiological asymmetry of the embryo, especially the change of dominance for right to dominance for left during gastrulation is discussed in relation to defects and situs inversions. (BBB)

50838 THE PROBLEM OF INCLUSION BODIES IN TUMORS. I. IN THE ANIMAL. Guerin, Maurice (Institut de Recherches sur le Cancer, Villejuif, France). Bull. Cancer, 54: 263-84 (July-Sept. 1967). (In French).

Induction of inclusion bodies by various agents, including x rays, is reviewed. In experiments described, x irradiation of mice of the IC strain resulted in appearance of inactive virus particles as paranuclear inclusions. The significance of inclusion bodies in tumors (they may be found even in plant tumors) is discussed. In animals they are most often attributed to a viral infection. The phenomenon was demonstrated in fish, amphibia, and birds, as well as in mammals. Among mammals, infective fibromas and

papillomas are the conditions most frequently encountered. It is stressed that inclusion bodies were found not only in mammary cancer, leukemia, and polyoma virus tumors in the mouse, but also in monkey SV40 virus and adenovirus tumors in other animals. However, this cellular alteration is nonspecific for it may be induced by simple virus infections of a temporary nature or by nonviral agents such as ionizing radiation. (BBB)

50839 EFFECT OF ELECTROMAGNETIC FIELD OF HHF (HYPER-HIGH FREQUENCY) OF DIFFERENT POWER AND DURATION ON NUCLEIC ACID CONTENT IN VISCERA. Vibe, K. G.; Faitel'berg-Blank, V. R. (Tsilinograd Agricultural Inst., USSR). Dopov. Akad. Nauk Ukr. RSR, Ser. B, 6: 553-6(June 1969). (In Ukrainian).

The effect of ultra high frequency electromagnetic field on the content of nucleic acid in digestive organs was investigated using 36 rabbits. The total content of nucleic acids in the liver, pancreas, stomach, small intestines, and blood, and the content of DNA and RNA in the same organs was studied. The results showed that the electromagnetic field changed the content of nucleic acids in the organs under investigation in dependence on the power and duration of the effect. Small doses of HHF (40 and 80 W) with the action of 10 min on epigastrium of rabbits considerably stimulated the content of nucleic acids (total and RNA), great doses (300 W) and doses of 40 W with 20 min action inhibited the content of nucleic acids. Desoxyribonucleic acid manifested a high resistance to the action of electromagnetic oscillations. Statistically authentic shifts in the content of DNA in the organs under investigation were evoked only by HHF doses of 80 and 300 W. (auth)

50840 CHANGES IN THE MARROW CELL CYCLE TIME FOLLOWING DEPOSITION OF ^{45}Ca IN BONE. Barranco, Sam C.; Doty, Stephen B.; Merz, Timothy (Johns Hopkins Univ., Baltimore). Contract AT(30-1)-3917. Amer. J. Roentgenol., Radium Ther. Nucl. Med., 106: 802-7(Aug. 1969).

The marrow cell generation time in rats at 6 days after ^{45}Ca injection was 1.5 hr shorter than that for control animals. The cell cycle time in treated animals was normal at 5 months. (C.H.)

50841 MARROW CELL INJURY FOLLOWING ^{45}Ca UPTAKE IN BONE: CHANGES IN MARROW AND PERIPHERAL BLOOD CELLULARITY. Barranco, Sam C.; Beers, Roland F. Jr.; Merz, Timothy (Johns Hopkins Univ., Baltimore). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 106: 794-801(Aug. 1969).

The amounts of ^{45}Ca used in metabolic studies in rats were small and the calculated radiation doses through the first six days when the most drastic hematologic changes were observed were low compared to x ray doses used in other experiments to perturb the normal steady state of the bone marrow. Nevertheless, the changes produced within the bone marrow in these rats receiving ^{45}Ca were as great, or greater in some instances, as those caused by larger x ray doses. Radiation from ^{45}Ca incorporated into the bones of the rats, caused cell death and accelerated cell removal within the mature marrow granulocyte pool. Mitotic delay or inhibition of the rapidly dividing and differentiating precursor cells plus the radiation-induced cell death caused a rapid and extensive decrease in the number of nucleated cells of the marrow. Since there were fewer mature cells in the marrow to cope with natural attrition rates in the peripheral blood, granulocytopenia resulted. Being unable to deliver mature cells for circulation, the marrow released large numbers of immature granulocytes, (bands), and reticulocytes into the blood. Until regeneration in the marrow is relatively advanced, a period follows when immature cells of the marrow predominate. Recovery approaches normal by five months after ^{45}Ca injection but cannot be considered to be complete since the ^{45}Ca is relatively fixed in the bone and will continue to cause radiation damage. (auth)

50842 OOCYTES IN THE TESTIS OF ^{131}I THYROIDECTOMIZED ADULT TOADS. Guardabassi, Antonietta; Signorelli, Irma; Clerici, Piera (Univ., Turin). Ric. Sci., 38: 976-9 (Oct. 1968). (In Italian).

In the testis of adult male toads, three months after ^{131}I thyroidectomy, the appearance of many oocytes of varying sizes and a pronounced degeneration of male germ cells was observed. The hypothesis is advanced that both the degeneration of male germ cells and oocyte development are not caused by ^{131}I radiations, but rather by an excess of androgens produced by the interstitial tissue of the testis, that in radiothyroidectomized animals is more developed than in controls. (auth)

50843 EFFECT OF IRRADIATION ON MORPHOLOGIC AND HISTOLOGIC CHANGES IN THE ANIMAL'S BODY. Osintseva, V. P.; Gubernskii, Yu. D.; Bonashevskaya, T. I.; Zubets, A. M.; Airapetyan, E. A. (Inst. of General and Public Protection, Moscow). Gig. Sanit., No. 7, 16-20(July 1969). (In Russian).

The acute and chronic effects of infrared radiation of various intensity on animals are discussed. Investigations included microscopic, electronic, and histologic methods. In optimal (according to the thermal state) intensities of infrared radiation no unfavorable changes developed in experimental rats and mice. Under the effect of infrared radiation of uncomfortably high intensity the homoiothermal animals demonstrated an active hyperemia of organs and a number of adverse functional shifts. (auth)

50844 EXPERIMENTS ON RELATIVE BIOLOGICAL EFFECTIVENESS OF 20-MeV ELECTRONS. Dutreix, A.; Dutreix, J.; Wambersie, A. (Gustave Roussy Inst., Villejuif, France). Ann. N. Y. Acad. Sci., 161: 272-81(July 3, 1969).

From Conference on High Energy Radiation Therapy Dosimetry, New York. See CONF-670665.

Two kinds of biological experiments were performed. The first determined the RBE of high-energy electrons as compared with high-energy photons, cobalt-60 γ rays, or conventional x rays. For these comparisons, biological samples (bacteria, yeast, mice, spleen colonies) were irradiated at the maximum of the depth-dose curve in all high-energy beams and at 3 cm depth in cobalt or x-ray beams. The second experiment determined the variation of the RBE of high-energy electrons with depth. From the results it was concluded that: The RBE of 20-MeV electrons is, for all the biological tests that we have used, equal to 0.85 with reference to 260-kvp x rays and equal to 1.0 with reference to high-energy photons, ^{60}Co γ-rays, or 20-MeV x rays. No variation of RBE was observed in depth down to about the 25% isodose level. Caution is advised in extrapolating results to more complex organisms such as mammalian cells or to chromosomal aberrations. It cannot be excluded that these are more sensitive to variations of linear energy transfer. (C.O.)

50845 THE REACTIVITY OF RAT PHRENIC-DIAPHRAGM PREPARATION AND RECTUS ABDOMINIS MUSCLE AFTER WHOLE-BODY IRRADIATION. Voicu, V. A.; Jiquidi, L.; Anania, D. (Center for Radiobiology and Molecular Biology, Bucharest). Atomkernenergie, 14: 366-8(Sept.-Oct. 1969).

On the rat phrenic nerve-diaphragm preparation pre-elevated 1, 4, 7, and 10 days after 400 and 800 R x rays whole-body irradiation, the response to curarizing substances was recorded. Both after irradiation with 400 R and 800 R the effects of d-tubocurarine presented at different time intervals a diphasic aspect: a decrease after 1st, 7th, and 10th day and a marked increase during the 4th day after irradiation. The modifications of the opposed effects of the paraoxonium and d-tubocurarine were chronologically and qualitatively superposed with the reactivity changes of the isolated organ to the curarizing drugs. On the rectus abdominis muscle of the frog irradiated with 10,000 x rays, the changes of the chronaxy and ^{45}Ca uptake were recorded. A significant increase of the chronaxy of frog rectus abdominis muscle after whole-body irradiation occurred. ^{45}Ca uptake in irradiated frog muscle showed modifications that were related to the active uptake of the cation. It was concluded that the changes in neuromuscular excitability after acute whole-body irradiation were the result of phasic changes of cholinesterase activity and of alteration of the active uptake of calcium. (auth)

50846 BEHAVIOR OF TRANSIT CELL POPULATIONS IN LETHALLY IRRADIATED RATS TREATED BY HOMOLOGOUS BONE MARROW CELLS. Smid, A.; Mraz, J. (University Hospital, Hradec Kralove, Czech.). Atomkernenergie, 14: 242-4 (July-Aug. 1969). DTIE;

Changes of some cell populations in the bone marrow of lethally irradiated rats after transfusion of homologous bone marrow cells were investigated. The investigations were performed during the first 48 hours following transfusion. Irradiated rats were given homologous cells labeled with ^{59}Fe or $DF^{32}P$ in several experiments. Measurements of ^{59}Fe and $DF^{32}P$ activity in peripheral blood and bone marrow were made. Only very few immature cells were temporarily taken. It can be presumed, that the greatest part of transfused cells did not leave the peripheral blood. Nevertheless, the numbers of youngest erythroid and myeloid percursors were increasing rapidly during the time of investigation, the proliferation process grew stronger especially between 12 to 18 hours. A necessary growth of stem cells and division of transit populations of erythroid and myeloid precursors is presumed before an output of cells for further differentiation occurs. (auth)

50847 THE RELATION OF PHYSICAL STRESS TO SERUM CHOLESTEROL LEVELS OF SELECTED BLOOD GROUP GENOTYPES IN THE DOMESTIC FOWL. Estep, Gary Dolan. College Station, Tex., Texas A and M Univ., 1968. 69p.

Thesis.

The effects of protein and energy level of the rearing diet on the serum cholesterol level of female chickens was determined. Females reared from 8 to 23 weeks of age on a diet containing 16% protein had a significantly lower serum cholesterol level than those reared on an 18% protein diet. The feeding of 947 or 1,003 Calories

of productive energy in conjunction with varying protein levels produced no significant differences in serum cholesterol levels. No significant differences in serum cholesterol levels were observed between females maintained at densities of 1,393, 696, and 464 cm^2 per bird during the laying period. Females reared on 12 and 14% protein diets had significantly lower serum cholesterol levels than those fed 18% protein in the 1,393 cm^2 density group. At the 696 cm^2 per bird density, the females on 18% protein diets had significantly lower serum cholesterol levels than birds reared on 12% diets. In the 464 cm^2 per bird density group, the birds reared on a 16% protein diet had significantly lower serum cholesterol levels than birds reared on 12, 14, and 18% protein diets. Immature male chickens exposed to 600 R of continuous irradiation showed a significant decrease in serum cholesterol level after irradiation. The 9-week-old males showed a significant decrease in serum cholesterol level at 2 hr postirradiation, while 12-week-old males had a significant decrease at 8 hr post-irradiation. The serum cholesterol level of 52-week-old males of B^2B^T and B^TB^T blood group genotypes were siginficantly increased by 3 weekly injections of 4 mg of diethylstilbestrol. No difference was found in the response of the two different blood group genotypes to implants of diethylstilbestrol. The serum cholesterol level of B^2B^T and B^TB^T females were significantly decreased by exposure to 600 R of continuous irradiation and 2 hr of exposure to either heat or cold stress. The serum cholesterol level of irradiation females was significantly depressed at 24 hr post-irradiation. The changes in serum cholesterol level of the mature female were not significantly related to the B blood group genotype of the female. The age of the immature bird had a significant effect on the level of serum cholesterol. The serum cholesterol level of 12-week-old birds was found to be significantly lower than at 6 weeks of age. The sex or the B blood group genotype of the immature bird had no significant effect on serum cholesterol level. (Diss. Abstr.)

50848 THE EFFECT OF Q-SWITCHED RUBY LASER ON RETINAL PIGMENT EPITHELIUM IN VITRO. King, Robert G. Jr.; Geeraets, Walter J. (Medical Coll. of Virginia, Richmond). Acta Ophthalmol., 46: 617-32(1968).

Explanted retinal pigment epithelium from the 10-day-old chick embryo was irradiated with a ruby laser and followed by direct microscopic observation and time lapse cinephotomicrography. This allowed direct measurement and detailed study of the exposed explant to ascertain irradiated damage, and to qualitatively and quantitatively study the characteristics of this damage at various microscopic spot sizes. The power densities, with small spot sizes, needed to produce a threshold lesion were determined. When the explants were exposed to Q-switched irradiation, an energy density of 0.11 J/cm^2, or power density of 3.8 mW/cm^2, produced a threshold lesion for spot sizes of 135 μ and 20 μ in dia. Threshold energy density seemed to be independent of spot size within the above range. Reversible damage could be produced in the pigment epithelial cells at a power density of 2.4 mW/cm^2 on the retina with a 20-min period of recovery. When the energy was increased six times above threshold, gross central cavitation was produced immediately after exposure with the formation of a bubble, probably steam. As the reversible or subthreshold energy level was approached, a temporary cessation of granule and cellular motion was seen. It appeared that some cellular component was damaged and this defect needed about 20 min to repair or reactivate itself so that normal cellular processes could resume. (BBB)

50849 COMPARATIVE STUDY OF LUNG CHANGES IN THE RABBIT FOLLOWING THORAX IRRADIATION WITH 200-KV X RAY, COBALT γ RADIATION, AND 17.3-MeV ELECTRONS. Kranz, D.; Kunz, J.; Degner, W. (Humboldt-Univ., Berlin). Frankfurt. Z. Pathol., 76: 361-9(1967). (In German).

Effects of irradiation of the thorax with 2000 to 12,000 R doses of 200-kV x rays, 17.3-MeV electrons, or ^{60}Co γ radiation were studied in adult rabbits. Survival times of the animals ranged from 10 min to 5 months. The general condition of the surviving animals was poor, although there was no direct relation to the irradiation dose administered. Studies of the lungs showed that there were no differences between the effects of the three types of irradiation used. There was an initial phase with marked changes in permeability, evidenced by vascular hyperemia, intra-alveolar edema, increased mucous secretion, and disappearance of lymphatic tissue, and a second stage of cellular metaplasia and marked exudative reactions. This was followed by polymorphonuclear changes of the alveolar walls, bronchial epithelium, and pleural wall cells. Intra-alveolar foam cell formation was observed subpleurally and peribronchially. Hyaline membrane formation was not observed, but calcifications and intra-alveolar bone formation were observed. (BBB)

50850 A DNA NEOFORMATION AND THE DEVELOPMENT OF MALFORMATIONS FOLLOWING WHOLE BODY X-RAY IRRADIATION OF EARLY EMBRYONAL SYSTEMS OF RATS: RADIOAUTOGRAPHIC STUDIES. Wegner, G.; Haas, R. (Univ., Freiburg i. B.). Verh. Deut. Ges. Pathol., 51: 282-7(1967). (In German).

Acute cell death, a restraint of three partial phases of the embryonic cell generation may continue until 24 hrs, and the phases of DNA-synthesis and mitosis cause radioinduced malformation. The result is a continuing reduction of mitosis. After a short interval between 24 and 48 hours p. X irr, with a ^3H-index equal to the control or slightly elevated, the number of DNA synthesizing cells decrease again cell death ensues, particularly in the cerebral-formation the increase of severe cerebral deformities can be seen at this time. (auth)

50851 50 PERCENT SURVIVING DAYS (SD_{50}) AS AN INDICATOR OF RADIATION EFFECTS. IN THE CASE OF PROTECTIVE EFFECTS OF GLUTATHION. Yasukochi, Hiroshi; Ihno, Yu (Tokyo Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 27: 691-6(Sept. 1967). (In Japanese).

The term $LD_{50/80}$ is popularly used as an indicator of radiation effects. To detect the effect of protective agents for radiation injury, $LD_{50/80}$ seems to be a good indicator. But the cause of death by radiation is supposed to depend on three origins, they are brain death, intestinal death, and bone marrow death. The $LD_{50/80}$ is based on normal distribution of radiation death, but in reality, the distribution of death is divided into two phases, intestinal and bone marrow death, for radiation doses between 100 and 1000 R. The term SD_{50}, which is mainly dependent on intestinal death, is suggested. The calculation of SD_{50} is the same as that of LD_{50}, but the survival rate is compared with the duration between the irradiation and the death. In short, SD_{50} means the days between irradiation and 50% of animals survived. $LD_{50/80}$ means the dose at which 50% of animals survived for 30 days after irradiation. As an example, some effects of glutathione are discussed. (NSA of Japan) (TSS)

50852 EFFECTS OF GRADED DOSES OF GAMMA RADIATION ON TRANSPLANTED PITUITARY GLANDS IN THE SPOTTED NEWT. Dent, James Norman (Univ. of Virginia, Charlottesville). Radiat. Res., 38: 223-9(Apr. 1969).

Excised pituitary glands from adults of the eastern spotted newt were subjected to gamma radiation ranging between 0.1 and 52 kR and were then reimplanted subcutaneously behind the lower jaw. Newts with autotransplanted pituitary glands are typically melanistic, presumably because the separation of the pituitary from the hypothalamus releases the pars intermedia from hypothalamic inhibition. No animals whose pituitaries had received 7.5 kR or more became melanistic, and melanism was seen in only 2 of 12 animals with glands irradiated at 5.0 kR. Molting, which is halted in newts deprived of either the thyroid or the thyrotropic hormone, continued unchecked in animals bearing autografts irradiated with 5.0 kR or less but was inhibited within 2 weeks in animals whose pituitary glands were exposed to 10 kR and within 60 days after 7.5 kR. Cytological examination of the transplanted glands revealed evidence of cellular damage, the extent of which was correlated with the amount of radiation they had received. The radiation sensitivity of the newt pituitary gland is apparently much greater than that of the toad and is not far removed from that of the rat. (auth)

50853 ROLE OF THE OLFACTORY SENSORY SYSTEM IN THE DETECTION OF X-RAYS BY THE RHESUS MONKEY. Taylor, Henry L. (Aeromedical Research Lab., Holloman Air Force Base, N. Mex.); Smith, James C.; Wall, Ann Hatfield; Chaddock, Barbara. Contracts F29600-67-0012; AT(40-1)-2903; AT(40-1)-2690. Physiol. Behav., 3: 929-33(1968).

The effect of bilateral sectioning the olfactory tracts of the rhesus monkey on the detection of x rays was studied. Immediate behavioral detection using the conditioned suppression technique was demonstrated in seven rhesus monkeys, and dose rate detection thresholds were determined for four of the subjects. The olfactory tracts of five experimental subjects were lesioned and two subjects served as surgical controls. Post-surgery behavioral testing demonstrated that complete bilateral sectioning of the olfactory tracts eliminated detection of x rays. The detection behavior of the control subjects remained unchanged. When part of one olfactory tract remained intact, detection was observed, but the dose rate detection threshold was less sensitive. (auth)

50854 PHYSICAL AND MICROSCOPIC STUDIES ON THE EFFECTS OF LASER BEAMS ON ENAMEL SURFACES. Lenz, E. (Friedrich-Schiller-Univ., Jena, Ger.). Deut. Stomatol., 18: 345-53(May 1968). (In German).

Microscopic studies and microhardness measurements were performed on laser-induced lesions of unchanged and stained enamel. The results show that the degree and the extent of the alterations at the site of impact depend upon the specific color of the irradiated specimen. (auth)

50855 DRUG TOXICITY IN MICE EXPOSED TO MIXED GAMMA-NEUTRON RADIATIONS. Davis, Lawrence W.;

Strike, Thomas A. (Armed Forces Radiobiology Research Inst., Bethesda, Md.). Proc. Soc. Exp. Biol. Med., 130: 788-92(Mar. 1969).

The acute toxicity (death within 24 hr) of 10 drugs representing four drug classes (anticonvulsants, hypnotics, hypoglycemics, and psychopharmacologics) was studied in irradiated male mice two hr, one and six days after 500 rad; 2 hr and 1 day after 1000 rad; and two hr after 10,000 rad whole-body doses of mixed gamma-neutron radiations. The LD_{10} value for each drug in irradiated mice was calculated and compared to the LD_{50} value obtained in unirradiated controls. The LD_{50} values for most drugs studied were altered significantly in some of the groups of irradiated mice. All drugs tended to be more toxic in irradiated mice on the sixth day following 500 rads. In general, the anticonvulsants were more toxic in mice receiving 1000 and 10,000-rad doses, while the psychopharmacologics were less toxic in the mice receiving 1000 rads but more toxic in those receiving 10,000-rad doses. (auth)

50856 ROLE OF ENDOTOXINS IN THE PATHOGENESIS OF HEMORRHAGIC SYNDROME IN ACUTE RADIATION SICKNESS. Volodin, V. M.; Oivin, V. I.; Tokarev, O. Yu.; Gumenyuk, L. I. Med. Radiol., 14: No. 8, 29-35(Aug. 1969). (In Russian).

The role of endotoxins of Gram-negative bacteria in the pathogenesis of hemorrhagic syndrome in acute radiation sickness was studied. Experiments conducted on irradiated rabbits both in conditions conducive to and preventing intravascular blood clotting under the influence of endogenous Gram-negative endotoxins demonstrated that the development of hemorrhagic diathesis in acute radiation sickness is not associated with the action of endotoxin on the blood and subsequent occurrence of thromborrhagia according to mechanisms of generalized phenomenon of Sanarelli-Swartzmann. Protracted introduction to nonirradiated guinea pigs of E. coli 0127:B_8 endotoxin (lipopolysaccharide, Difko) and endotoxin isolated from E. coli, notwithstanding intoxication also showed the inability of endotoxins of Gram-negative bacteria to cause hemorrhagic syndrome similar to radiation. (auth)

50857 THERAPEUTIC EFFECT OF DESOXYRIBONUCLEIC ACIDS AND NUCLEOTIDES IN EXPERIMENTAL RADIATION SICKNESS. Mazurik, V. K. Med. Radiol., 14: No. 8, 74-84 (Aug. 1969). (In Russian).

A brief review is given on influence of treatments with DNA on the survival of irradiated animals. Tabulated data are included on the effects of DNA on the 30 day survival of rats and mice irradiated with 600, 700, 850, 900, and 1000 R. Summarized analysis of published data indicated favorable therapeutic effects of DNA preparations. However, it is stressed that the role played by initial DNA structure on the therapeutic effects and the specific effects of DNA as compared with synthetic polyanions are not yet known and depend on the final decoding of the mechanisms of therapeutic influence of DNA and further studies. (R.V.J.)

50858 PRELIMINARY REPORT ON THE EFFECTS OF L-TRIIODOTYRONINE, RADIOACTIVE ^{131}I, AND METHIMAZOLE ON EXPERIMENTAL MURINE LEPROSY. Gutierrez, Rodrigo (Univ., Valle, Colombia). Leprosy Rev., 38: 31-3(Jan. 1967).

The effects of thyroid-related compounds on mice infected with the Stefansky bacillus, were investigated. Mice treated with ^{131}I had less granulomata in the liver and other organs than the controls. Animals treated with 1-triiodothyronine had less than 28 granulomata/mm^2 of liver tissue. The magnitude of the differences between the 1-triiodothyronine and the control groups, was so great that it did not seem to be the result of mortality selection. The results were similar to the findings in experimental tuberculosis. The data seemed to indicate some protective action of ^{131}I and of 1-triiodothyronine on experimental infection with the Stefansky bacillus. (BBB)

50859 OBSERVATIONS ON THE EFFECT OF DIFFERENT INTRAPERITONEAL MEDIA ON DEGREE OF TISSUE DESTRUCTION CAUSED BY ULTRASONIC RADIATION IN THE RAT MESENTERY. Valtonen, Erkki J. (Univ. Central Hospital, Helsinki). Arch. Pathol. Anat., 343: 136-41(Dec. 12, 1967).

Irradiation of rats was carried out at a frequency of 1 Mcps and intensity of up to 3 W/cm^3. The effects of intraperitoneal salt solutions and air on the degree of tissue destruction produced by irradiation in the rat mesentery were studied. The degree of tissue destruction was greatest in the animals that were injected with air in the peritoneal cavity, and this also corresponded to the increase of body temperature caused by the irradiation. Salt solution, although a good transmitting medium, had a cooling effect; therefore, with it the destruction of the tissue and the increase of the body temperature were less. The average body temperature rise caused by irradiation was 0.5°C. The rise in the body temperature of the animals injected with air in the peritoneal cavity was caused by the reflection of ultrasound. Reflection occurs at boundaries or interfaces, i.e., the surfaces common to two different media. (BBB)

50860 EXPERIMENTAL STUDIES ON RADIOACTIVE ^{85}Sr. Yoshii, Hirobumi (Kumamoto Univ., Japan). Kumamoto Igakkai Zasshi, 43: 427-43(May 1969). (In Japanese).

Strontium-85 is one of the radioisotopes that recently was used frequently for diagnosis of malignant tumors in bone. The accumulation of ^{85}Sr in organs of animals depending on difference of their age was investigated. Following administration of ^{85}Sr to rats, they were killed and dissected at regular intervals, and the up-take of ^{85}Sr in various organs, such as the femur, lung, liver, kidney, spleen, muscle, and blood was measured. The influence of ^{60}Co γ irradiation on accumulation of ^{85}Sr in the femur was also investigated. Doses ranging from 2000 to 8000 R were administered to the left femur of adult rabbits. The scintiscan of the irradiated femur was compared to that of the non-irradiated femur. The results showed that the accumulation of ^{85}Sr in the femur of the younger rats showed the highest value and that of the older showed the lowest, and the accumulation of ^{85}Sr in the femur of the middle aged rats was found between these values but the degree of the concentration of ^{85}Sr in the bone, was much higher as compared with that in other organs. It was noted that the degree of concentration of ^{85}Sr in the bone was elevated as demonstrated by the scintigram after 4000 R irradiation to left femur. (NSA of Japan.)

50861 BLASTOMOGENOUS ACTION OF FAST NEUTRONS (NEW GROWTH IN THE SKIN, SUBCUTANEOUS CELLS, AND MUSCLES). Gerasimova, T. B. Fiziol. Zh., Akad. Nauk Ukr. RSR, 14: 401-2(May-June 1968). (In Ukrainian).

Development of new growth in the skin, subcutaneous cells, and muscle tissues was observed in animal 12 months after exposure to single whole-body irradiation by fast neutrons. Studies were made with 500 white rats (200 females and 240 males) exposed to single whole body irradiation with 25, 50, 200, and 400 rad in nuclear reactor horizontal channel with γ background not exceeding 10%. Formation of tumors began six to nine months after exposure. The highest number of tumors was observed in animals exposed to 400 rad (17%) while irradiation with 25, 50, and 200 rad induced respectively 8, 7, and 6% tumors. Maximum number of new-formed skin, subcutaneous cells and muscles appeared following exposure to 25, 50, and 200 rad about 15 to 18 months from the day of exposure. (R.V.J.)

50862 EXPERIMENTAL INVESTIGATIONS CONCERNING INFLAMMATORY CHANGES IN THE ANTERIOR SEGMENT OF THE WOUNDED EYE OF RABBITS TREATED BY TV AND RABBITS WITH RADIATION SICKNESS. Manna, Feliks; Meyer, Jerzy; Zbozynski, Stefan. Klin. Oczna, 38: 893-6(1968). (In Polish).

A morphological evaluation was made of inflammatory and productive changes of the anterior eye-segment, occurring in the course of healing of perforating corneo-scleral wounds and of isolation of a foreign body in the anterior chamber of rabbit eye in three groups of rabbits: (I) control nontreated; (II) with changed body's reactivity, caused by injection of nonspecific stimulus (typhoid vaccine), and (III) in the course of radiation sickness caused by sublethal doses of x rays. (auth)

50863 EFFECTS OF ^{32}P IN IONIC FORM ON THE CELLS OF EHRLICH'S ASCITES TUMOR. Piccotti, F.; Cirillo, R.; Ferrero, B.; Ballaira, L. (Univ., Turin). Cancro, 20: 303-22 (1967). (In Italian).

The influence of pretreatment in vitro of ascites tumor cells with ^{32}P, on the mitotic index and proliferating activity of the cells was studied. The cells were then inoculated in rats. An increased mitotic index was observed in cells treated with low doses and a proportional lower index in those submitted to a more elevated dose of radiation. Some conclusions are reported on the influence of this treatment in relation to the dosage and animal survival. (auth)

50864 COMPARATIVE MORPHOLOGICAL AND FUNCTIONAL (ERG) STUDIES ON THE RETINA OF THE RABBIT AFTER IRRADIATION WITH GAMMA RAYS (^{60}Co) AND HIGH-ENERGY ELECTRONS. Lommatzsch, P.; Fuerst, G.; Ulrich, W. D. (Humboldt Univ., Berlin). Arch. Klin. Exp Ophthalmol., 175: 34-45(Apr. 30, 1968). (In German).

Morphological and functional changes found in the rabbit eye after irradiation with γ rays (^{60}Co) and highly energetic electrons are described and the effects of both radiation qualities are compared. Radiation injuries were found by ERG and by histological examinations after a dose of 5000 R. The most radiosensitive parts of the retina are the outer and inner segments of the rods. Next comes the outer nuclear layer. Pyknoses of the bipolar ganglious cells of the inner nuclear layer were found after 6000 to 8000 R. The big ganglious cells did not show any morphological injuries after 10,000 R. No significant difference was found between the effects of 8.5 MeV electrons and ^{60}Co γ rays. It was striking that after electron irradiation with 8000 R the ERG was

abolished in all tested cases, while 10,000 R of γ rays were required to produce the same effect. One factor only does not seem sufficient to characterize the relative biological effect. (auth)

50865 RADIOINDUCED AVOIDANCE CONDITIONING AND INTRACRANIAL SELF-STIMULATION. Stonecypher, John Franklin. Athens, Ga., Univ. of Georgia, 1968. 56p. Thesis.

The possibility of extending the radioinduced aversive conditioning phenomenon to include intracranial self-stimulation (ICSS) as the conditional stimulus was studied. Electrodes were implanted in the extreme posterior hypothalmus (supramammillary area) in 14 male albino rats. All subjects were tested daily for ICSS rates. Testing periods were 15 min in duration. After 6 days, response rates stabilized and two matched groups of seven rats were selected to serve as sham-irradiated control subjects, and as irradiated subjects. Response rates remained stable for the control group throughout the 5-day experiment. Irradiated animals showed a significant decrease in response rate during irradiation (50 R, 280 kVP), a significant increase in response rate on the first post-irradiation day, and a subsequent return to the pre-irradiation levels. Thus no evidence for radioinduced aversive conditioning was found. Results were discussed in terms of the motivational properties of ICSS, and suggestions concerning the possible sensory system determinants of radioinduced aversive conditioning were made. (Disser. Abstr.)

50866 AN AUTORADIOGRAPHIC AND CYTOPHOTOMETRIC STUDY OF THE RATE OF INCLUSION OF ^{3}H-THYMIDINE INTO THE CELLS OF REGENERATING LIVER, SUBJECTED TO IRRADIATION AT THE G_1 AND S-PERIOD. Polishchuk, A. M.; Gunderina, L. I. (Inst. of Cytology and Genetics, Novosibirsk, USSR). Dokl. Akad. Nauk SSSR, 185: 686-9(Mar. 21, 1969). (In Russian).

The rate of ^{3}H-thymidine uptake by the cells of regenerating liver during the G_1 and S period was studied using (150 to 160 g) male rats x-irradiated and 10.5 hr and 22 hr after operation involving the removal of $^{2}/_{3}$ of the liver. An intraperitoneal injection of 0.25 μC per g dose of ^{3}H-thymidine was given to all animals 22 hr following the operation. Tabulated data are given for the rate of the labeling at various stages of S period. Autoradiographic data showed that the uptake rate of nuclei and chromosomes increased towards the end of the S period. The data obtained confirmed the hypothesis that there existed two stages in the processes of DNA synthesis which are controlled by various factors. (R.V.J.)

50867 STUDIES OF COMBINATION INJURIES. PART 13. EFFICACY OF EVIPANE AND EPONTOL IN WHOLE-BODY IRRADIATION COMBINED WITH OPEN SKIN INJURIES. Messerschmidt, Otfried; Langendorff, Hanns; Rossner, Reinhard; Heppeler, Gerlinde (Univ., Freiburg i. B.). Strahlentherapie, 137: 626-33(May 1969). (In German).

Mice of the NMRI strain either were irradiated with 510 R, or received a cutaneous wound, or received a combined lesion of irradiation and wounding. The skin wound was made either before, simultaneous or after the irradiation. These different lesions caused in all animals a modified sensitivity against the two narcotics, Evipan and Epontol. Skin wounding or total body irradiation cause only a small and relatively slight modification of the sensitivity. Combined lesions however result in a marked modification. The LD_{50} value of Evipan and Epontol is reduced by one third, and the narcose-duration is much more prolonged. (auth)

50868 EFFECTS OF FAST NEUTRON IRRADIATION ON DEVELOPING RAT EMBRYO. Okamoto, Naomasa (Hiroshima Univ.); Inoue, Akira. Hiroshima J. Med. Sci.; 17: 169-96(Sept. 1968).

Studies were conducted to evaluate the effects of 14.1 MeV fast neutron on the developing rat embryo from the teratological viewpoint. A single and whole-body irradiation of 80, 100, or 130 rad was performed on pregnant rats at 7 to 11 days of gestation. Resorption, i.e., embryonic mortality, increased with dose increment and growth retardation was noticed in all irradiated fetuses at autopsy. Higher dose of radiation contributed to the increase of sex ratio, indicating a higher susceptibility in female embryos. Malformation was detected in 671 fetuses (62.3%), and increased with dose increment. In the body system, cardiovascular anomalies were most frequent (516), followed by hernia (167), malformation of the central nervous system (147), extremities and tail anomalies (70), face anomalies (44), urogenital anomalies (25), and others (20). On the other hand the highest incidence of malformation (94.1%) occurred by irradiation with a dose of 130 rad 8 days after conception, and cardiovascular anomalies were also highest (84.6%) by this irradiation. However, the critical periods of malformations were sometimes different in the same body system. These data indicate varying sensitivities of the mammalian embryos at different stages of gestation to anomaly-producing effects of irradiation. Malformations of two or more body systems were detected in 295 (44%), most frequently associated with the cardiovascular anomalies. Of them, the combination of anomalies of cardiovascular and central nervous systems was highest in incidence. These results suggested that early embryos might develop through the interaction of each dermal cell. The usefulness of fast neutron as a teratogen for the study of teratogenesis, especially of morphogenesis of cardiovascular anomalies was emphasized. (NSA of Japan)

50869 THE RELATIVE RADIOSENSITIVITY OF THE YOUNG AND THE ADULT LENS. Merriam, George R. Jr.; Focht, Elizabeth F.; Parsons, R. Wayne (Columbia Presbyterian Medical Center, New York). Radiology, 92: 1114-15(Apr. 1969).

One eye of female white rats aged three and one-half and eight and one-half weeks was x-irradiated at 800 rads, and the development of cataracts was determined. The younger rats were the first to develop cataracts, but the older rats developed greater stages of opacity earlier than the younger rats. Subsequent experiments with different ages and doses tended to confirm the initial results. (E.R.B.)

50870 PROBLEMA PORAZHENIYA KROVETVORNOI TKANI PRI OSTROI LUCHEVOI PATOLOGII. (The Problem of Damage to the Hemopoietic Tissue During Acute Radiation Pathology). Gruzdev, G. P. Moscow, Izdatel'stvo Meditsina, 1968. 140p.

Aspects related to the mechanisms of destruction and restitution of hemopoietic tissues in radiation pathology are reviewed. The basic marrow wasting causes and the mechanisms responsible for marrow damage during radiation sickness are discussed. The problems of high-radiosensitivity of marrow are analyzed. 116 Russian and 194 foreign references are included. (R.V.J.)

50871 GASTRIC RETENTION AND ITS CHANGES IN MICE AND RATS DURING THE FIRST SIX DAYS FOLLOWING X-IRRADIATION. Chmelar, Vladimir; Grossmann, Vojtech; Hais, Ivo M.; Deml, Frantisek (Charles Univ., Hradec Kralove, Czech.). Radiat. Res., 37: 627-35(Mar. 1969).

Retention of $^{35}Na_2SO_4$, $^{45}CaCl_2$, and 1-^{14}C-glycine in the stomach following intragastric administration has been studied in irradiated mice and rats. Simultaneously, blood levels of these substances have been determined. Following whole-body x irradiation (600 R, exposure rate 17.7 R/min, HVL 1.03 mm Cu), retention of gastric contents takes place in mice and rats, yet its course is not identical in both species. As soon as 30 minutes postirradiation, high retention of gastric contents is observed in both mice and rats, which must be attributed to the influence of ionizing radiation. In mice, on the first day following irradiation the evacuation of gastric contents returns to normal, but another retention maximum occurs about 2 to 3 days postirradiation. Six days following irradiation, more rapid evacuation of gastric contents is found in irradiated mice than in the control animals. In rats, delayed evacuation of the stomach is found at all the time intervals investigated (up to the sixth day), the highest values being found during the first days (up to the third day). Blood levels of the substances vary inversely with the gastric levels. This demonstrates the importance of retention as a factor which influences the rate of absorption of all substances in irradiated animals. (auth)

50872 EFFECT OF LOCAL ROENTGEN IRRADIATION ON THE ACTIVITY OF VARIOUS ENZYMES OF THE SUBMANDIBULAR GLAND IN RATS. Fuchs, P. (Univ., Erlangen-Nuernberg, Ger.). Deut. Zahnaertztl. Z., 23: 674-81(June 1968). (In German).

Morphological investigations on irradiated mandibular salivary glands of rats showed definite histological changes only after 16 days. In order to determine whether earlier metabolic changes occurred after irradiation of these salivary glands several enzymes were examined. In one enzyme (G-6-PD) a decrease of activity could be found already after 24 hrs and a renewed rise after 7 days. The remaining enzymes examined (LDH, GOT, amylase) showed no significant change in activity with radiation doses of 500–6000 ROD. Enzyme activity in connection with cell damage after x radiation is discussed. (tr-auth)

50873 PRODUCTION OF ACHLORHYDRIA IN RATS BY DIRECT IRRADIATION OF THE STOMACH. Murray, M. John; Stein, Nell; Mathews, John; Deyo, Rita (Univ. of Minnesota, Minneapolis). Proc. Soc. Exp. Biol. Med., 131: 737-9(July 1969).

Lasting achlorhydria was produced in rats by x irradiation of the exposed stomach. Gastric pH determination in the living animal correlates well with the degree of impairment of gastric acid secretion induced by irradiation. Rats treated in this way provide a good experimental model comparable to an animal with

total gastrectomy but without the disadvantage of an interrupted gut. (auth)

50874 CHANGES OF THE ENZYME DISTRIBUTION PATTERN IN RABBIT OVARY AFTER X-RAY IRRADIATION. Brandau, Hartmut; Lehmann, Urte; Luh, Wilfried (Univ., Kiel). Z. Geburtsh. Gynaekol., 168: 51-64(Dec. 1967). (In German).

Histochemical techniques were used to demonstrate glycolytic oxidoreductases, the citrate and glycerophosphate cycle, and the pentose-phosphate-shunt in the ovary of normal and irradiated rabbits 4 weeks after exposure to 250, 500, 1000, and 2000 R. The granulosa cells as the structures most sensitive to irradiation were destroyed after doses between 250 and 500 R. Beyond an irradiation with 1000 R, intact ova cannot be found any more. The interstitial tissue proved to be particularly insensitive to roentgen irradiation. Even after a dose of 1000 R, the characteristic high activities of glycolytic and $NADPH_2$-supplying oxidoreductases can be found in the interstitial cells. Only 2000 R lead to a drop in the activity of these enzymes in the interstitial tissue. These findings suggest that after irradiation with 1000 R the interstitial tissue at least fulfils a residual endocrine function. (auth)

50875 EFFECT OF IRRADIATION TO THE CENTRAL NERVOUS SYSTEM UPON THE MOVEMENT OF THE DISTAL COLON. Kawakami, Masazumi; Negoro, Hideo; Kimura, Fukuko (Yokohama City Univ., Japan). Yokohama Med. Bull., 19: 63-73(June 1968).

The effect of ^{60}Co γ radiation applied to the central nervous system on the movement of the large intestine was investigated in rabbits. Enterostomy was carried out on their colon and intestinal movement was recorded by means of an electric manometer using a balloon that was inserted into the large intestine. Doses of 100 R, 200 R, 500 R, and 1000 R of γ radiation were applied to the head, the spinal cord, and the large intestine. During the experiment the rabbits were free to move around on an observation table. Observation was made for 12 to 24 hrs. When 100 to 1000 R of γ radiation was applied to the head, the movement of the large intestine was noticeably reduced after a latent period of approximately one hr. This change continued for two or three hr after irradiation of 100 R and for over 24 hr after irradiation of 1000 R (in all cases, intestinal motility returned to a completely normal level afterwards). When the thoracic and lumbar segments of the spinal cord were irradiated, the intestinal movement was also reduced. When the sacral segment of the spinal cord was irradiated, the motility of the large intestine was accelerated. When the large intestine was irradiated locally, even with 1000 R, its movement was not affected. After the removal of sympathetic nerve supply to the large intestine, the intestinal movement was not influenced by head irradiation of either 500 R or 1000 R. After the removal of parasympathetic nerve supply, the movement of the colon was reduced as much as that of the intact animals was by head irradiation. It was concluded that a moderate dose of γ radiation has a stimulating effect on both sympathetic and parasympathetic nervous function. However, the former appears to be more sensitive than the latter. (auth)

50876 PATHOLOGY OF INTERNAL VISCERA FOLLOWING LASER IRRADIATION. Laor, Y.; Simpson, C. L.; Klein, E.; Fine, S. (Roswell Park Memorial Inst., Buffalo). Amer. J. Med. Sci., 257: 242-58(Apr. 1969).

Visceral lesions in mice were produced through the intact skin using the following lasers: normal-mode ruby laser operating at 6943 Å, normal-mode neodymium laser operating at 10,600 Å, and CO_2 molecular laser operating in the ir 10.6 μ. The energy levels used for pulsed laser irradiation ranged between 30 and 400 J, to produce typical visceral lesions through the intact abdominal wall. With the CO_2 laser, the mice were exposed to the continuous beam for various periods of time at power levels ranging up to 24 W. About 30 J/cm^2 obtained from a ruby laser, or 56 J/cm^2 obtained from a neodymium laser at a beam diameter of about 1 cm, was found to be the minimal energy density levels required to produce a visible hepatic lesion when the intact skin of a 2- to 3-month-old Swiss mouse irradiated directly without focusing. The threshold level for grossly observable lesions in surgically exposed livers was about 15 J/cm^2 unfocused irradiation at 6943Å. Gross and microscopic changes following laser irradiation resembled lesions produced by other heat-producing agents, but differed in selectivity for pigments and production of pressure effects. The variations in the lesions of different organs appeared to be due primarily to differences in pigment content, tissue structure, and response to injury. The rapid temperature rise during pulsed laser irradiation led to vaporization of tissue fluids causing large intercellular spaces with cellular distortion. The pressure waves produced changes resembling blast injuries. Lesions produced by CO_2 lasers showed primarily thermal changes. (BBB)

50877 NOTES ON THE EFFECTS OF β-RAYS FROM $^{90}Sr-^{90}Y$ ON SPERMATOGENESIS IN THE TELEOST, ORYZIAS LATIPES. Yoshimura, Nobuko; Etoh, Hisami (National Inst. of Radiological Sciences, Chiba, Japan). Annot. Zool. Jap., 42: No. 2, 75-9(June 1969).

Adults of Oryzias latipes were kept in tap water containing 1 or 10 μCi of ^{85}Sr/l for periods varying from 1.5 hours to 15 days. A considerable amount of the radioactive isotope was accumulated by the gonad. If males were reared in water containing 1 or 10 μCi of ^{90}Sr/l for about two to four weeks during the breeding season spermatogenic cells in the testes were severely damaged. Dividing spermatogonia and spermatocytes were most sensitive to ^{90}Sr-radiation, while mature sperm were resistant. In the testes of fish kept in water containing 10 μCi of ^{90}Sr/l for a 30 day-period, almost all spermatogenic cells were destroyed and disappeared. The testes were similar in histological structure to those of fish irradiated with x rays from the outside of the body. The damaged testes of such fish failed to recover at least within 15 days after they were transferred into normal tap water. (NSA of Japan)

50878 ENHANCEMENT OF RADIATION-INDUCED MITOTIC INHIBITION BY URETHANE IN THE ERYTHROBLASTS OF CHICK EMBRYOS. Diwan, B. A.; Batra, B. K. (Tata Memorial Centre, Bombay). Acta Haematol., 41: 55-61(1969).

White Leghorn chicken eggs were incubated until the definitive primitive streak stage, then were x irradiated with 250 R and subsequently incubated for 82 hr to obtain 4-day-old embryos. Urethane (0.25%) was injected into the albumen of some of the unincubated hen's eggs near the embryonic axis. The percentage distribution of mitotic phases in the embryonic erythroblasts was determined. After treatment with x rays alone, there was a relative decrease in the percentage of cells in prophase and a distinct rise in the percentage in anaphase and telophase, whereas the percentage of cells in metaphase was not significantly altered. After the combined treatment with urethane and x rays, there was a considerable decrease in the percentage of prophase and a distinct rise in the percentage of cells in metaphase. The percentage of cells in later phases (anatelophase) was not different from normal. The mitotic index reached a peak after the combined treatment with x rays and urethane. This distinct rise of mitotic index was caused by a large increase of cells in metaphase and a general rise of cells in other mitotic phases. The increase in the mitotic index after irradiation alone (2.5616) resulted from an equal increase of all phase indices. Distinct morphological changes were observed in erythroblasts during the course of mitosis both in the specimens treated with x rays alone or with urethane followed by x rays. Clumping and sticking together of the chromosomes were the most striking effects. The most frequent changes were found in the anaphase stage and consisted in chromosomal bridges and acentric fragments. The spindle mechanism was occasionally incomplete or absent. Binucleate cells were common after the treatments, and showed an incomplete membrane between two potential cells, or more frequently, the membrane was absent and the cell was a true binucleate cell. Instances in which the chromosomes of one daughter nucleus disintegrated during mitosis were also found. Enhancement of radiation effects when urethane was administered and possible mechanisms responsible for the radiation-induced mitotic inhibition are discussed. (BBB)

50879 THE STATE OF THE ACID OF MUCOPOLYSACCHARIDE IN THE CEREBRAL CASING DURING ACUTE RADIATION SICKNESS. Izmailova, G. M. (Inst. of Biophysics, Moscow). Med. Radiol., 13: No. 6, 86-7(June 1968). (In Russian).

A total of 22 dogs were irradiated with five dogs being included in a control group. One group of seven dogs was given a lethal γ dose of 900 R (lethal dose for dogs is 350 R). The life duration was 3½ weeks at this dose. Another group of nine dogs was given a dose of 650 R. This group lived for nine to 12 weeks. The animals in the first group were killed one hr, and one and three days, and those in the second group one hr, one, three, five, seven, and nine days after irradiation. The brain tissue was fixed in 10% neutral formalin. Acid mucopolysaccharides were differentiated by coloring with toluidine blue, by treating sections with hyaluronidase, or by methylation. A sharp increase in acid polysaccharides was noted in the first few hrs after irradiation as compared to the controls. Metachromatic granules could be detected around veins and arteries. Then three to five days after irradiation a sharp decrease in metachromatically colored material was observed. Enzyme treatment with hyaluronidase and methylation showed that most of the metachromatically colored material belonged to hyaluronic acid, with a small amount belonging to chondroitin sulfate. It is hypothesized that the penetrability of the brain barrier during severe radiation sickness may be due to the formation of hyaluronic acid. (TTT)

50880 EFFECT OF MASSIVE BLOOD TRANSFUSION ON THE THERAPEUTIC EFFICIENCY OF HOMOGENIC BONE

MARROW IN ACUTE RADIATION ILLNESS. Seraphimov-Dimitrov, V.; Decheva, Z.; Nedyalkova, M. (Inst. of Haematology and Blood Transfusion, Sofia). pp 67-73 of Bone-Marrow Conservation, Culture, and Transplantation. Vienna, International Atomic Energy Agency, 1969.

From Conference of Panel on Bone-Marrow Conservation, Culture, and Transplantation, Moscow. See STI/PUB-219; CONF-680721.

Simultaneously with bone-marrow transplantation, the blood of the lethally irradiated recipient animal was replaced with blood from the bone-marrow donor. From experiments on dogs and rabbits it became clear that replacing 86% of the recipient's blood with blood from the bone-marrow donor considerably reduces the therapeutic effect of bone-marrow transplantation. The authors consider that the main cause of the animals' early death in experiments combining bone-marrow transplantation and massive donor blood transfusions is a secondary syndrome resulting from the graft-versus-host reaction. This does not exclude the inverse possibility — that the development of a host-versus-graft reaction is due to the presence of a massive number of antigens of the donor blood in the blood of the recipient. (auth)

50881 STEM-CELL INACTIVATION ON TRANSPLANTATION OF HAEMOPOIETIC CELL SUSPENSIONS FROM GENETICALLY DIFFERENT DONORS. Petrov, R. V. (Inst. of Biophysics, Moscow). pp 59-66 of Bone-Marrow Conservation, Culture, and Transplantation. Vienna, International Atomic Energy Agency, 1969.

From Conference of Panel on Bone-Marrow Conservation, Culture, and Transplantation, Moscow. See STI/PUB-219; CONF-680721.

The transplantation of a mixture of haemopoietic or lymphoid cells from two genetically different mice into lethally irradiated F_1 recipients results in marked or total inactivation of the colony-forming units of the graft. This phenomenon is observed following transplantation of mixtures of spleen cells or bone-marrow cells from animals of different genotypes: CBA + C57BL, A + CBA, A + C57BL, C3H + C57BL, CBA + (CBA × C57BL) F_1. Maximum inactivation is observed when lymph node cells of one genotype are transplanted with spleen or bone-marrow cells of another genotype. Use of non-syngenic kidney cells or lymphoid cells inactivated by irradiation as one component of the mixture shows that inactivation of genetically heterogeneous stem cells requires the participation of viable lymphoid cells. The inactivation phenomenon is also observed with Jerne's method. This shows that inactivation affects not only colony-forming cells but also the immunologically competent precursors of antibody-producing cells. (auth)

50882 ARE HAEMOPOIETIC STEM CELLS PRECURSOR CELLS IN SECONDARY DISEASE? Chertkov, J. L. (Central Inst. of Haematology and Blood Transfusion, Moscow). pp 49-50 of Bone-Marrow Conservation, Culture, and Transplantation. Vienna, International Atomic Energy Agency, 1969.

From Conference of Panel on Bone-Marrow Conservation, Culture, and Transplantation, Moscow. See STI/PUB-219; CONF-680721.

Data on acute secondary disease developing in supra-lethally irradiated dogs and monkeys after transplantation of allogenic bone marrow are presented. On the basis of the experimental data obtained, the question whether haemopoietic stem cells play a role as first links in the histogenesis of the lymphoid elements responsible for acute secondary disease is discussed. (auth)

50883 YAVLENIE PRONITSAEMOSTI V RAZVITII LUCHEVYKH PORAZHENII. (Vascular-Tissue Penetrability During Radiation Injuries). Balmukhanov, S. B.; Sergazin, A. G. Alma-Ata, USSR, Izdatel'stvo Nauka Kazakhskoi SSR, 1968. 167p.

A review of the literature on the effects of radiation on the porosity of barrier systems is presented. Investigations of the state of overall porosity of vascular systems in the vascular-tissue barriers of organs and the tissues of animals that were subjected to whole-body and local irradiation in lethal and sublethal doses are included. Changes of sorption activity and the porosity of vascular tissue to vital dyes in internal organs of irradiated animals were demonstrated, and also in erythrocytes and tumor cells. The states of potassium-sodium equilibrium and serotonin content of blood and tissues of irradiated animals were also determined. An attempt was made to normalize the altered porosity of vascular-tissue barriers with vasotropic compounds. The monograph is composed of radiobiological, radiotherapeutic, and other literature that relates to the questions of pathogenesis of radiation injuries to the organism and its cellular elements. (auth)

50884 OTNOSITEL'NAYA BIOLOGICHESKAYA EFFEKTIVNOST' IZLUCHENII. FAKTOR VREMENI OBLUCHENIYA. (Relative Biological Radiation Effectiveness. Radiation Time Factor). Domshlaka, M. P. (ed.). Moscow, Atomizdat, 1968. 376p.

A review of the literature, and of the author's own data regarding the relative biological efficiency of different types of radiation and certain established general rules is presented. RBE coefficients for different types of radiation, different species of animals, and various biological criteria were constructed. The clinical manifestations of radiation sickness following the action of radiations of different types were compared. The role of dose rate, dose fractionation, and the general time of irradiation were systematically studied. Data regarding the influence of dose rate on model systems and different living organisms revealed certain rules regarding the influence of different dose rates on the different types of radiation sickness. Similar analysis permitted the evaluation and presentation of materials concerning the mechanism of the effects of dose rate on biological reactions. (auth)

50885 CARCINOGENIC ACTION OF 7.12-DIMETHYLBENZ (α) ANTHRACENE ON IRRADIATED SKIN. Turusov, V. S. (Inst. of Experimental and Clinical Oncology, Moscow). Vop. Onkol., 14: No. 8, 66-71(1968). (In Russian).

Following continuous application of 0.0025% benzol solution of 7.12-dimethylbenz (α) anthracene (DMBA) on irradiated skin of mice (C57BL × CBA) enhanced chemical carcinogenesis was noted, as shown by shortening of the average latent period of tumor appearance, greater number of tumor-bearing animals, increase of the average number of tumors per animal, and higher incidence of precancerous conditions (by keratoacant) and malignant neoplasms. The incidence of malignant tumors from combined effect considerably ($p < 0.01$) exceeded total incidence of cancer and sarcomas developed as a result of separate use of radiation and DMBA. The persistent presence of chemical carcinogens in the irradiated skin was considered to be the most probable cause of enhanced carcinogenesis. (auth)

50886 ISOAMYLASE PATTERN IN FETAL AND MATERNAL RAT ORGANS AND BODY FLUIDS DURING FETAL DEVELOPMENT UNDER NORMAL CONDITIONS AND AFTER WHOLE-BODY X IRRADIATION WITH 800 R. Goetze, T. (Friedrich-Schiller Univ., Jena, Ger.). Wiss. Z. Friedrich-Schiller-Univ., Jena, Math.-Naturwiss. Reihe, 17: 20-1(Jan. 1968). (In German).

Patterns of isoamylase in organs and serum of maternal rats and fetuses after x irradiation with a whole-body dose of 800 R were studied. Activity of amylase associated with the γ-globulins increased in maternal serum. The concentration in the blood was increased indirectly by an increased release into the blood of pancreatic amylase. This was probably due to blockage of the pancreatic duct that followed the irradiation of the intestinal tract. The isoamylase patterns of the pancreas, serum, saliva, and jejunum of the adult rats and rat fetuses were measured. Isoamylase patterns in the labyrinth and junctional zone of the placenta, and in the amniotic fluid of the rat were compared. Within 48 hr of birth the isoamylase pattern in serum of newborn rats was very similar to that in the adult sera. (BBB)

50887 CHANGES IN THE ELECTRORETINOGRAM EVOKED BY LIGHT AND X-RAY STIMULATION IN VARIOUS STATES OF THE RETINA. Savchenko, B. N. Nerv. Sist., 8: 97-101(1967). (In Russian).

Response of the retina to electric stimulus and x irradiation during artificially induced changes in the physiological state was studied in male grass frogs. Effects of polarization, direct current, hypoxia, hypoxy, hypophysectomy, and sodium azide administration were investigated. The results indicated that ionizing radiation affects the retina by luminescence and by damaging nerve cells. (R.V.J.)

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Refer also to abstracts 50370, 50393, 50416, 50417, 50481, 50517, 50549, 50553, 50559, 50560, 50564, 50570, 50588–50590, 50604, 50608, 50629, 50641, 50642, 50644, 50646, 50648, 50649, 50748, 50749, 50751, 50755–50758, 50768, 50770, 50771, 50777, 50778, 50782, 50785, 50788, 50790–50792, 50794, 50803, 50805, 50806, and 50870.

50888 (CONF-671135–, pp 193-8) RECENT PROGRESS IN ASSESSMENT OF HUMAN RESISTANCE TO TOTAL-BODY IRRADIATION. Lushbaugh, C. C. (Oak Ridge Inst. of Nuclear Studies, Inc., Tenn.).

Human resistance to whole-body irradiation was assessed in relation to data on response of clinical patients to whole-body irradiation. Probit regression analysis of data yielded estimates of the effective single doses required to cause various incidences of the untoward responses of acute radiation sickness and hema-

topoietic damage. Results are presented in tabular form. It was suggested that dose protraction would reduce the incidence of injuries caused by prompt one-dose exposures. (C.O.)

50889 (JPRS-48481) HEMODYNAMIC CHANGES IN INDIVIDUALS WORKING UNDER MICROWAVE IRRADIATION. Fofanov, P. N. Translated from Kardiologiya, 9: No. 4, 124-6(1969). 4p. CFSTI.

An in-depth investigation of the circulatory system of individuals exposed to ultrahigh frequency irradiation for a long period of time revealed that there is a tendency toward bradycardia and moderate decrease in stroke and minute volume of the heart, without any appreciable change in mean hemodynamic pressure. Corresponding to the decrease in stroke and minute volume there was some decrease in volumetric output rate and power of the left ventricle. There was some compensatory constriction of the precapillary bed in response to the mild decrease in cardiac output. The arteriolar reaction was adequate (actual peripheral resistance corresponded to the working resistance). In addition in a number of cases the major arterial vessels presented increase tonus. Evidently these compensatory adaptive mechanisms provided maintenance of a normal level of mean dynamic pressure. The electrocardiographic changes were indicative of stronger vagotonic influences on the heart. Some of the subjects showed signs of overload of the left ventricle and changes that could be indicative, to some extent, of fluctuations of potassium-sodium balance in the myocardium. (auth)

50890 (PHS-999-RH-33, pp 54-8) HEMATOLOGICAL EFFECTS OF RADIATION. Loutit, John F. (Medical Research Council, Harwell (England). Radiobiological Research Unit.).

The sensitivity of hemopoietic tissues of man to radiation is considered with respect to acute massive exposure and chronic exposure. Acute massive exposure effects are discussed in relation to the events that occur after irradiation and the count of the elements of the peripheral blood; the usefulness of these changes for making clinical predictions are discussed. Chronic exposure is discussed in relation to the incidence of leukemia in the known cases of chronically exposed persons. (C.O.)

50891 (PHS-999-RH-33, pp 139-44) THE SYMPTOMATIC AND HAEMATOLOGICAL DISTURBANCE FOLLOWING TOTAL BODY RADIATION OF 300-RAD GAMMA-RAY IRRADIATION. Rider, W. D. (Toronto Univ. (Ontario)); Hasselback, R. (Ontario Cancer Inst., Toronto).

Children and adolescents afflicted with Ewing's tumor and in good clinical condition underwent whole-body ^{60}Co γ irradiation at a dose of 33 Rad. Characteristic symptomatic and hematological response with little individual variation was observed. Vomiting occurred regularly 45 to 60 minutes after irradiation and persisted 6 to 8 hr. Maximum hematopoietic depression occurred between 25 and 30 days postirradiation. Hematopoietic recovery was rapid and best handled by barrier nursing, antibiotics, and blood transfusions as indicated by the clinical situation. No dose rate dependency could be demonstrated. (C.O.)

50892 (PHS-999-RH-33, pp 145-52) EPIDEMIOLOGY OF LATE EFFECTS OF RADIATION IN MAN. Hilberg, Albert W. (National Center for Radiological Health, Rockville, Md.).

Definition of epidemiology and breakdown into descriptive and analytical epidemiology are discussed. The genetic effects as late radiation effects are discussed briefly. Somatic effects are listed as increased rate of carcinogenesis, accelerated aging, increased rate of congenital or fetal abnormalities, and cataract formation. It was concluded that progress in understanding the late radiation effects is still at an elementary level. (C.O.)

50893 THE NATURAL HISTORY AND MANAGEMENT OF RADIATION INDUCED INJURY OF THE GASTROINTESTINAL TRACT. DeCosse, J. J.; Rhodes, R. S.; Wentz, W. B.; Reagan, J. W.; Dworken, H. J.; Holden, W. D. (Case Western Reserve Univ., Cleveland. University Hospitals, Cleveland). Ann. Surg., 170: 369-84(Sept. 1969).

From 89th Annual American Surgical Association, Cincinnati, Ohio. See CONF-690424.

One hundred patients who sustained significant radiation induced injuries of their gastrointestinal tract before and after the introduction of supervoltage therapy were analyzed. The injuries comprised proctitis in 44 patients, rectal ulcer in 10, rectal stricture in 19, rectovaginal fistula in 29, colitis in 17, ileitis or jejunitis in 25, and rectal polyps in one and a carcinoma in one that was possibly induced by radiation. Urinary tract injury was frequently associated. Death was attributed to recurrent cancer in 28 patients and to radiation injury of the gastrointestinal tract in 22. When a subset of 34 injured patients with carcinoma of the cervix was contrasted with 227 uninjured patients treated during the same 10-year interval, gastrointestinal damage and progression of injury correlated significantly ($p < 0.025$) with hypertension, less so with diabetes or arteriosclerosis, and not at all with age, race, or clinical staging. Small cell cancer of the cervix or a previous supracervical hysterectomy was observed more frequently in injured patients. In 25 patients, gastrointestinal injury was not manifested for at least two years after therapy. A delayed appearance of a complication often related to the advent of cardiovascular disease. There was an additive relationship between low splanchnic blood flow from systemic vascular disease and radiation vasculitis. Limited surgery was attended by a high mortality and a high complication rate, particularly late intestinal perforation. The evidence favored an extensive intestinal resection in the management of small bowel injury. (auth)

50894 RADIATION TOLERANCE OF THE THORACIC SPINAL CORD. Phillips, Theodore L.; Buschke, Franz (Univ. of California, San Francisco). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 105: 659-64(Mar. 1969).

Three instances of radiation myelitis of the thoracic spinal cord were found among 350 patients treated for carcinoma of the lung, esophagus, and trachea, or for thymic tumors, 40 of whom survived more than 18 months. These 3 patients and the 37 additional patients surviving more than 18 months after irradiation were studied in detail. The time-dose relations were reviewed and analyzed as a function of number of fractions and of over-all treatment time. The results suggest that the number of fractions is the most important factor in the determination of late radiation damage to the spinal cord. It is concluded that radiation myelitis can probably be prevented by avoiding an excessive total dose to the spinal cord and by planning treatment that does not deliver more than 200 rads per fraction. (auth)

50895 THRESHOLDS OF LASER EYE HAZARDS. Zweng, H. Christian; Vassiliadis, A.; Peppers, N. A.; Peabody, R. R.; Honey, R. C. (Stanford Research Inst., Menlo Park, Calif.). pp 75-85 of Transactions of the 33rd Annual Meeting of the Industrial Hygiene Foundation of America, Inc., Transactions Bulletin No. 42. October 15-16, 1968, Chatham Center, Pittsburgh, Pa. Pittsburgh, Industrial Hygiene Foundation of America, Inc., 1969.

See CONF-681062.

Effects of laser radiation on rabbit, monkey, and human eyes are reviewed. Lasers that emit light with wavelengths in the visible and near-ir parts of the spectrum are transmitted well by the ocular media, and the eye's optics focus the beam giving intense concentrations of light energy on the retina. For lasers in the far-ir, the radiation is highly absorbed in the surface body tissues; thus corneal damage can result from these powerful radiation sources, such as the CO_2 laser. Such radiation can give corneal scarring and likewise result in visual loss. The data reported were intended to simulate accidental field exposures. Corneal damage levels caused by CO_2 laser radiation were shown to be consistent with a simple thermal model. It was also shown that the Caucasian human fundus is appreciably less sensitive to damage from laser radiation compared to the rhesus monkey fundus. In general, the human threshold data were considerably higher than some of the recommended safe levels. Within the range of exposure times investigated, damage occurred to the cornea when it was exposed to power levels that gave corneal temperatures of about 67°C, assuming a normal corneal temperature of 32°C. (BBB)

50896 RADIOTHERAPEUTIC PROBLEMS IN GYNECOLOGIC CANCER THERAPY. Zur Horst-Meyer, H. (Humboldt Univ., Berlin). Zentralbl. Chir., 92: Suppl., 2041-4(1967). (In German).

The incidence and severity of fibrosis and other changes in patients irradiated with fractionated doses of x or ^{60}Co γ irradiation were reported and discussed. After irradiation with ^{60}Co delayed excretion was observed in 14 patients, cystitis in nine, and ureteral stenosis, hydronephrosis, or silent kidney was observed in 10 patients. Fibrotic changes were observed in from 7.5 to 13% of irradiated patients, and ranged widely in severity. Indurative changes included pelvic connective tissue fibroses. Other changes included intestinal fibroses, ureteral stenoses, and proctitis. These changes appeared within 10 months to 2.5 yr after irradiation. The incidence of bone necroses was from 0.5 to 1.6%, depending on whether the treatment given was combined x ray and Ra or ^{60}Co and Ra. (BBB)

50897 DENTAL RADIATION HAZARD. Frommer, Herbert H. (New Jersey Coll. of Dentistry, Jersey City). J. N. J. State Dent. Soc., 39: 327-30(May-June 1968).

Radiation effects in humans are reviewed, and some recommendations and practical suggestions are made for reductions of x-ray dosage in the dental office. A 16-film series taken with high-speed dental films at 65 kVp, 10 ma, and an 8-in. focal film distance will give the patient's head a radiation dose of about 3 R. The gonadal dose would be about 0.3 mR. The gonadal dose should be limited to

10 R above the natural background in the 0- to 30-yr age group. Radiographic examinations should not be made periodically or be a standard part of every dental examination and should only be used if the information to be obtained will contribute to proper diagnosis and prevention of disease. However, it is suggested that every new patient should have a full-mouth series of radiographs to serve as a basis for a dental record. Periapical films should be taken at the maximum every 3 yr. In areas where endodontics was performed, radiographic follow-ups should be much more frequent. The most effective way to reduce radiation to patients without affecting diagnostic information is the use of fast film. (BBB)

50898 FIVE-YEAR CURE RATE OF THE CERVIX UTERI, WITH SPECIAL REFERENCE TO THE COMPARISON OF SURGICAL AND RADIATION THERAPY FOR CARCINOMA. Masubuchi, Kazumasa; Tenjin, Yoshio; Kubo, Hisamitsu; Kimura, Mitsuo (Cancer Inst. Hospital, Tokyo). Amer. J. Obstet. Gynecol., 103: 566-73(Feb. 15, 1969).

A comparison of complications caused by surgery and irradiation was made in 2145 cases of cervical carcinoma treated with either of the two methods. For intracavitary Ra application, colpostat and tandem were used at the same time. Colpostat consisted of five tubes of 10 mg and tandem of two tubes of 20 mg Ra inserted for 23 hr at intervals of 5 to 10 days, three times. The total dose was 6210 mg-hr. The parametrial dose of additional external x-ray therapy was about 1500 R and telecobalt radiation was given later to patients up to the maximum of 2000 to 4000 R. The 5-yr cure rate in operated cases was 90.5% in Stage I and 74.4% in Stage II; following radiotherapy the rates were 88.2 and 68.7%, respectively. Though the rates were slightly better after operation, statistical analysis revealed no significance to the difference. Urinary complications occurred in 47.1% of the cases following operation and in 23.5% following irradiation. Pollakiuria was seen in 23.5% after operation. Following irradiation, 19.6% had pollakiuria. Intestinal complications occurred in 63.9% of the cases following operation and in 28.2% following irradiation. As for intestinal complications, constipation was the most troublesome (63.4%) in the operative group and rectal bleeding was the most frequent complaint (20.3%) after irradiation. In 35.9% and 14.8% of the patients, respectively, temporary impairment of sexual function occurred following treatment. Thrombocytopenia was twice as frequent in irradiated cases. Bleeding and coagulation times were considered normal. Urea nitrogen levels were slightly higher in 4% following operation and in 16% following irradiation, but no patient had uremia. A normal blood sedimentation rate (within 30 mm/hr) was found in 80% following operation and in 70% following irradiation. Cystitis occurred in 12% after operation and in 14% after irradiation. (BBB)

50899 TREATMENT OF POLYCYTHEMIA VERA. Rev. Clin. Espan., 111: 81-2(Dec. 15, 1968). (In Spanish).

Recent reports on the use of ^{32}P to treat polycythemia vera are reviewed and the accompanying hazards and complications are evaluated. The incidence of acute leukemia in the ^{32}P-treated patients was found to vary from 0 to 30% in the different reports, with an average of ~15%. Other evidence supporting the leukemogenic action of ^{32}P in this disease is assessed, such as the occurrence of chromosome anomalies in leukocytes of treated patients and the relation between the radiation dose and leukemia incidence rate in different studies. The vascular complications in polycythemia are the major cause of death in this disease, and the results of clinical studies indicate that early treatment with ^{32}P reduces the incidence of these complications, such as cerebrovascular accidents, gastrointestinal hemorrhage, myocardial infarction, and pulmonary embolism. The effectiveness of ^{32}P in lowering mortality from the disease has also been attested to, particularly when it is used with chemotherapy. However, patients treated with ^{32}P and antimitotic agents such as busulfan may develop side-reactions, including nausea, vomiting, skin lesions, thrombocytopenia, and occasionally hemorrhage. Up to 30% of patients given combined therapy may respond with these reactions. It was concluded that, in spite of severe short- and long-term side-effects that may occur, ^{32}P is a very effective treatment in polycythemia vera. (BBB)

50900 ULCER AND FISTULA IN BLADDER AND RECTUM AS COMPLICATIONS OF THE RADIATION TREATMENT OF CERVICAL CARCINOMA. Rotte, K. (Univ., Wuerzburg, Ger.). Zentralbl. Gynaekol., 90: 1149-59(Aug. 24, 1968). (In German).

The frequencies of appearance of ulcers and fistulas of the bladder and rectum after irradiation treatment of cervical carcinomas were reported and discussed. Out of 1315 patients studied for a follow-up period of 10 yr the incidence of ulcers of the bladder was 4.4%. Fistulas of the bladder amounted to 0.16%. Ulcers of the rectum appeared in 0.61%, and rectal fistulas were observed in 0.08%. Ulcers of both the bladder and rectum appeared in 0.32%, but there were no fistulas of both organs in any patient. In a series of 245 irradiated patients observed for 2 yr there were 0.41% bladder ulcers and 3.25% rectal ulcers. The calculated statistical probabilities of lesions were greatest in patients who received from 5000 to 7000 mg-hr of Ra treatment, and were least in patients who received less or more than this amount of Ra treatment. The percentage of recurrences of the tumor was almost the same in patients with or without irradiation lesions of the bladder and rectum. The possible causes of these irradiation lesions were discussed. (BBB)

50901 RADIOSENSITIVITY IN CUTANEOUS EPITHELIOMAS. Cantarino, Maria Helena; Melo, Joaquin Soto. Acta Oncol., 6: 67-85(Jan.-June 1967). (In Spanish).

The radiosensitivity of the different cellular components in basocellular and spinocellular epitheliomata was studied. In basocellular epitheliomata, four types of cells were isolated and their morphological and cytochemical characteristics are described. Type I cells are very radiosensitive, and this property decreases in the following types, in such a manner that types III and IV are only slightly radiosensitive. For spinocellular epitheliomata, three kinds of cells were isolated, as established above, under cytomorphological and cytochemical criteria. They all are characterized by a lack of DNA, whereas they are rich in RNA and even the most undifferentiated cells present a DNA content far below the normal level and their contents are approximately half of that presented by type I cells corresponding to basocellular epitheliomata. Those extracellular factors that may modify the radioresponse in both types of tumors were studied. Cellular community or group factors were analyzed by autoradiography through the incorporation of tritiate thymidine into the cell nucleus. (auth)

50902 RESULTS OF IRRADIATION OF BLADDER TUMORS BY TELECOBALT. (STATISTICS OF PAVILION V). Bobillon, J. (Clinique d'Urologie, Lyon). J. Urol. Nephrol., 74: 469-76 (June 1968). (In French).

Complications arising from ^{60}Co teleirradiation of bladder tumors in 39 patients are reported along with clinical results. Usually the subjects received 4500 R in 6 to 8 weeks. It was difficult to distinguish development of radioinduced complications from tumor recurrence. The complication rate was high (75%), with early complications (6 months postirradiation) occurring in 33.8%. Five cases showed only early sequelae while eight others also showed late side-effects. Three general reactions required cessation of treatment, three developed dysuria, five hematuria, 11 severe cystitis, and two transient rectitis. Late complications appeared after the 6th month, in 62.4%, and were generally serious. They included 11 cases of hematuria, 11 shrunken bladder, four scarring of the neck of the bladder, three cystitis, two fistulas (rectovesical, hypogastric), nine skin lesions, one ureteral sclerosis, and seven retracted bladders. Total mortality was 65% and the 5-yr survival rate was 13%. (BBB)

50903 CYLINDROMA (REMOTE) AND GRANT FOLLICULAR LYMPHOBLASTOMA WITH PARAPLEGIA FOLLOWING RADIATION THERAPY IN A 62-YEAR-OLD WOMAN. Vandervort, William J.; Lang, Leonard P. (Wilmington Medical Center, Del.). Del. Med. J., 40: 286-94(Sept. 1968).

A clinical-pathological conference presenting a case of radioinduced myelopathy is reported. On the supposition that the patient had lymphomatous infiltration of the calvarium without localizing signs, x-ray therapy was given to the cranium. The radiation dose was under the levels of dose at which radiation myelopathy has been reported; roughly 1900 rad in air in 3 weeks to the upper spine in 1965, with retreatment with 1400 rad in 1967. The immediate cause of death was Proteus septicemia secondary to acute pyelonephritis. The urinary tract infection was probably associated with the neurogenic bladder. This in turn was a result of radiation myelopathy. When the entire spinal cord was exposed at autopsy, there was no evidence of extramedullary or intramedullary tumor tissue. Microscopic sections revealed widespread degenerative changes especially in the lumbo-dorsal regions. All portions of the cord were involved with spongy degeneration and vacuolization, and some fibrous thickening of the leptomeninges. There was an increase in capillaries and arterioles with hyaline thickening of these vessels. Myelin degeneration was observed in some of the nerve roots. The changes were attributed to radiation damage. (BBB)

50904 THE RECOGNITION OF RADIATION AFFECTIONS OF THE LIVER WITH THE AID OF SCANNING. Zubovskii, G. A.; Galchenko, L. I.; Savchenko, E. D.; Kornev, I. I. (Moscow Scientific-Research Inst. of Roentgen-Radiology). Med. Radiol., 14: No. 9, 18-25(Sept. 1969). (In Russian).

Sixty patients with cancer of the stomach were irradiated by means of a betatron with an energy of 25 MeV. The zone of the beam of bremsstrahlung involved part of the left lobe of the liver,

which received from 1000 to 8000 rad. Patients were subjected to scanning of the liver before and after radiotherapy. In 23 persons a macroscopic description of the liver was done during the operation. Histological investigations of liver preparations were made at autopsy in 9 deceased. It was established that in part of the irradiated liver radiation fibrosis developed, the severity of which depended on the irradiation dose. In irradiation of the liver in a dose less than 3000 rad regeneration subsequently took place. In irradiation of the liver in a dose over 3000 rad processes of restoration ran a less intensive course and at irradiation doses of 5000 and more rad restoration was not observed and radiation fibrosis developed in this area. (auth)

50905 HISTOLOGIC BONE MARROW FINDINGS IN POLYCYTHEMIA VERA BEFORE AND AFTER ^{32}P THERAPY (AT THE SAME TIME A CONTRIBUTION TO THE DIFFERENTIAL DIAGNOSIS OF THE CLINICAL FEATURE POLYCYTHEMIA). Hauswaldt, C.; Hunstein, W.; Uhl, N.; Doering, P. (Univ., Goettingen, Ger.). Arch. Klin. Med., 213: 219-36(1967). (In German).

The effect of ^{32}P on bone marrow was studied 6 months to 5 yr after treatment of patients with total doses of 4.0 to 36.2 mCi of ^{32}P, given as single doses of 3 to 5 mCi. Iliac crest biopsies performed on 14 untreated cases of polycythemia vera and on 20 cases treated with ^{32}P revealed a hyperplasia of the blood-forming tissue, a diminution of fatty tissue, and an enlargement of the marrow sinusoids in both groups. The possible leukemogenic effect of ^{32}P therapy is discussed on the basis of these results and reports in the literature. The number of patients in the present series is too small to draw any conclusions, but, in general, the prolongation of life by the use of ^{32}P seems to allow more time for the development of malignant changes in the bone marrow that may be associated with the primary disease. (BBB)

50906 INFLAMMATORY CELLULAR REACTIONS IN PATIENTS WITH NEOPLASMA TREATED WITH HIGH ENERGY RADIOTHERAPY. Morandini, G. C.; Gerna, G.; Carosi, G.; Cerra, E. (Univ., Pavia, Italy). Arch. Sci. Med., 124: 497-505(Nov. 1967). (In Italian).

Inflammatory reactions were studied in the skin of patients following high-energy electron therapy of primary pulmonary neoplasms. Doses of 7,200 R were used for some cases. Differential leukocyte counts were made microscopically on stained tissue samples from inflamed areas taken from 6 to 48 hr following irradiation. An initial reduction in the number of leukocytes was followed by infiltration by mononuclear cells and an increase in the number of eosinophiles, with the maximum number present from 24 to 48 hr following irradiation. The possible function of leukocytes in the inflammatory response in man is discussed. (C.H.)

50907 RADIATION NEPHRITIS AFTER GASTRIC IRRADIATION FOR PEPTIC ULCER. Thompson, Peter L.; Mackay, Ian R. (Royal Melbourne Hospital). Gastroenterology, 56: 816-17(Apr. 1969).

Gastric irradiation is effective in reducing the hypersection of gastric acid in association with peptic ulcer. A possible complication, namely, late onset radiation nephritis, is described. Between 1948 and 1956 a group of 84 patients with peptic ulcer was treated by gastric irradiation and, in most cases, limited gastrectomy (antroduodenectomy). The radiation was given to the left upper quadrant of the abdomen via anterior and posterior portals. The total tissue dose was 1500 to 2000 rad and was given in divided doses over three weeks. A high prevalence of hypertension was noted in the irradiated group; therefore, these patients were examined for detailed assessment of renal function, including pyelography and radiological measurement of renal size. Of the 84 patients irradiated, 32 were found to have evidence of renal disease and/or hypertension. Biopsy or necropsy specimens of kidney were examined histologically in 14 patients. The main features were arterial intimal sclerosis of the medium-sized interlobular arteries, marked interstitial fibrosis, and scattered areas of tubular atrophy and dilation. These findings are similar to those of radiation nephritis. The clinical course and functional defects were similar to those described earlier in patients who suffered renal damage after upper abdominal irradiation for seminoma. The possibility that slowly developing radiation nephritis is a delayed hazard of treatment of peptic ulcer by irradiation is suggested. (BBB)

50908 THE PLASTIC SURGICAL REPAIR OF X-RAY ULCERS OF THE LATERAL NECK REGION (EPAULET FLAP). Bruck, H.; Klos, I. (Krankenhaus der Stadt, Vienna). Wien. Med. Wochenschr., 118: 394-5(Apr. 27, 1968). (In German).

The effects of x irradiation on skin of the neck are discussed and their repair by plastic surgery is described. The histological skin changes produced by x irradiation included loss of the cutaneous appendages; replacement of the normal collagen connective tissue by a particularly dense, cell deficient, hyaline tissue which contained numerous elastic fibers; obliterative processes in the blood vessels of the corium immediately below the epidermis; and during the early stages in the region of thrombosed teleangiectases which disappeared later, reparative proliferation of the epidermis inward from the sides, keratoses, and transition into ulceration or carcinoma. Radioinduced injuries of the side of the neck infrequently reached the stage of ulceration even though the neck received irradiation routinely in mastectomy. The reason for the relative insensitivity of the neck to irradiation is the excellent nutritional action of the highly vascular platysma beneath the skin and the lack of bone or other tissues that absorb large amounts of radiation, such as the bony ribs of the thorax. When ulceration of the neck developed, it involved necrosis of the sternocleidomastoid muscle and the skin surrounding the internal jugular vein. (BBB)

50909 RADIUM VITA EMANATOR: AN UNUSUAL POTENTIAL RADIATION HAZARD. Jelliffe, A. M.; Stewart, F. S. (Mt. Vernon Hospital, Northwood, Eng.). Brit. Med. J., 2: 305-6(May 3, 1969).

A device for producing Rn water was evaluated as a hazard to human health. The Radium Vita Emanator was on sale to the public in the 1930's. It contained a Ra source with arrangements for collecting the evolved Rn in solution, and the makers claimed, and recommended as the optimum dosage, a daily output of 10 μCi. The main features of its internal construction are shown. In Rn ingestion the organ receiving the highest dose is the stomach. A daily intake of 10 μCi as recommended by the Radium Vita firm would result in an annual x-ray equivalent dose to the dividing cells of the gastric epithelium of 800 rem. In comparison, the recommendations of the International Commission on Radiological Protection permit a maximum of 0.5 rem/yr for the general population, or 1.5 rem/yr for a small group of individuals. The strength of a source yielding 10 μCi of Rn per day (assuming 100% efficiency of extraction) is about 60 μCi of Ra. This is 1000 times the permissible body-burden of Ra. The escape of as little as 0.1% of the Ra present would constitute a serious hazard by present-day standards. In the device examined, the measured activity of the Ra source was 90 μCi. The Rn content of the water was 23 μCi. (BBB)

50910 COMMERCIAL SUPERSONIC TRANSPORTATION AND THE PATIENT. Stonehill, Robert B.; Murray, Raymond H. (Indiana Univ., Indianapolis). J. Indiana State Med. Ass., 61: 1645-7(Dec. 1968).

At altitudes over 55,000 feet, the filtering effect of the atmosphere affords little protection from irradiation. Two types of irradiation penetrate from space, cosmic and solar flare irradiation. Between 55,000 and 65,000 feet, cosmic irradiation poses no problem. During a transatlantic Supersonic Transportation (SST) flight, a passenger would receive a much lower whole-body exposure from this source than from having a chest x-ray taken. It was concluded that the radiation exposure of the individual crew member and passenger in SST's does not pose special problems except for the technicality of classing SST crew members as radiation workers, that results from their recurrent exposures. Solar flare activity could be more serious. Solar flares can cause excessive radiation exposures and cannot be predicted in advance with certainty. The next period of maximum activity will not occur until 1969 and it appears that flares giving 4 rem per hour (an excessive dosage) at altitudes of more than 65,000 feet probably will occur about twice a year. Each aircraft flying above 50,000 feet will carry radiation monitoring systems and when they indicate an excessive exposure, the airplane will descend to lower altitude. (F.M.M.)

50911 RADIUM TREATMENT OF BENIGN UTERINE BLEEDING: LONG-TERM FOLLOW-UP. Villasanta, Umberto; Rubel, Harold (Univ. of Maryland, Baltimore). Obstet. Gynecol., 33: 813-18(June 1969).

The incidence of malignancies in patients who had undergone Ra treatment for benign causes of uterine bleeding was evaluated in comparison to a control group not treated with Ra. Between 1933 and 1953 it was common for patients to receive intrauterine Ra therapy when they experienced excessive uterine bleeding near the menopause. In the irradiated group, following examination of the endometrium, 100 mg of Ra was placed into the uterine cavity, where it remained for 20 to 24 hr. The γ dose received by all these patients was in the range of 2000 to 2400 mg-hr. Of the 174 irradiated patients, 15 developed pelvic malignancy during the 10 yr period of observation. One carcinoma of the endometrium and a fibrosarcoma were diagnosed less than four yr after irradiation. The remaining neoplasms were first noted after an interval of more than four yr. All but two tumors fulfilled the 4-yr asymptomatic interval requirement suggested for a cause-and-effect relation between irradiation and malignancy. In addition to the pelvic malignancies, seven breast carcinomas were found in the irradiated group. In the control group of 147 patients only three malignancies were found during follow-up: one adenocarcinoma of the ovary

after a 10-yr interval, one brain tumor after 20 yr, and one adenocarcinoma of the breast. Ten irradiated patients and four in the control group developed diabetes mellitus. The difference in pelvic malignancy rate in the two groups (7.47 vs 0.68%) was statistically significant. It is concluded that the limited amount of radiation applied (2000 to 2400 mg-hr) might have been responsible for DNA damage sufficient to produce mutations, that eventually lead to neoplastic cellular proliferation. (BBB)

50912 SARTORIUS MUSCLE INTERPOSITION FOR THE TREATMENT OF THE RADIATION-INDUCED VAGINAL FISTULA. Byron, Ralph L. Jr. (City of Hope Medical Center, Duarte, Calif.); Ostergard, Donald R. Amer. J. Obstet. Gynecol., 104: 104-7 (May 1, 1969).

Radiation injury in a patient with cervical cancer is reported, and a new technique for the repair of radiation-induced vaginal fistula is described. Radiation treatment had been given with 5000 rad externally to an unshielded pelvis followed by 4500 rad with a vaginal mold. Nine months following therapy intractable pelvic pain began that culminated in the perforation of the rectovaginal septum at the apex of the vault. Transplantation of the sartorius muscle was used to supply the operative site with abundant vascularity necessary for healing. The accessibility of this muscle and the segmental nature of its innervation and blood supply make it ideally suited for this procedure. Muscle transplants have the advantage of supplying a rich vascularity by a tissue that is resistant to infection. Previously described techniques have utilized either the gracilis or adductor longus muscles. (BBB)

50913 PROBLEM OF THE OPTIMAL RADIOIODINE THERAPY OF GRAVE'S DISEASE. Fazakas, S. (Medical Univ., Debrecen, Hungary). Acta Med. Acad. Sci. Hung., 26: 31-40(1969). (In German).

Frequency of hypothyroidism induced by ^{131}I treatment of thyrotoxicosis was studied in 109 patients. A fractionated treatment, consisting of an initial dose of from 2 to 6 mCi of ^{131}I and a second dose of 2 to 4 μCi of ^{131}I, was given to 27 of the patients. The other 81 patients were given doses calculated on the basis of thyroid wt. Those whose thyroid wt was less than 62.5 g received 64 μCi/g, and those with thyroid wt of more than 62.5 g received an additional 32 μCi/g. The doses in these patients averaged 20% less than in the first group. The frequency of hypothyroidism and recurrence of thyrotoxicosis observed in the 109 patients was 1.9%. During a follow-up period of 4 yr, the frequency of hypothyroidism was 4.96%. The results of these treatments and others, where the estimated thyroid irradiation doses ranged from 3000 to 15,000 rep and from 7000 to 10,000 rad were discussed and compared. (BBB)

50914 REMISSION OF CHRONIC MYELOID LEUKEMIA AFTER SPLENIC IRRADIATION: MECHANISM OF ACTION OF A HUMORAL FACTOR. Maurice, P. A. (Centre d'Oncohematologie de l'Hopital, Geneva). Schweiz. Med. Wochensch., 98: 1667 (Oct. 19, 1968). (In French).

Demonstration of a cytostatic principle in the blood after radiotherapy in leukemia is reported. Five patients with chronic myeloid leukemia in relapse were given splenic x irradiation with single doses of 200 to 400 R, this treatment being repeated two or three times depending on the total individual dose required to achieve complete hematologic remission. Serum samples obtained from each patient before and 3 hr after irradiation were tested on suspensions of normal human bone marrow grown in a medium containing colchicine. In all five cases tested in this in vitro system, postirradiation serum significantly depressed the erythroblastic mitotic index as compared with the same cultures run with preirradiation serum. The mitotic index was 5.7% with the postirradiation serum compared with 8.9% with the preirradiation serum. The preirradiation value (8.9%) of leukemic serum was not significantly different from that of normal serum (9.6%). (BBB)

50915 BLADDER LESIONS FOLLOWING IRRADIATION IN THE AREA OF THE SMALL PELVIS. Pupato, F. (Kantonsspital, St. Gallen, Switzerland). Ther. Umsch., 25: 277-85(May 1968). (In German).

Irradiation of the pelvic area may affect the bladder either early by epithelial alterations or later by changes in connective tissue and in the vascular system. If occurring, these changes are difficult to treat; therefore, prophylaxis requires the avoidance of infection and strictures. Systematic examination of the urinary tract is a prerequisite for the prevention of complications during radiotherapy. (H.B.G.)

50916 STUDIES IN SPACE RADIOBIOLOGY. Saksonov, P. P.; Antipov, V. V.; Davydov, B. I. Probl. Kosm. Biol., 9: 1-532(1968). (In Russian).

A detailed study was made of biological effects of cosmic radiation combined with other factors encountered during cosmic flights. An analysis was made of the natural sources of ionizing radiation (cosmic and solar radiation) and nuclear sources from cosmic apparatuses in the artificial satellites. Data obtained under experimental and clinical conditions simulating cosmic radiation and new permissible doses were evaluated considering the early somatic effects, hematological changes, effects of partial body exposure, and effects on central and peripheral nervous systems. Effects of electromagnetic emissions, protons, deuterons, neutrons, α particles, and heavy ions are analyzed and cosmic pharmacology and chemical protection against radiation injuries are discussed. Criteria of permissible doses for astronauts during flights in rockets and high-elevation ballons are estimated. An extensive list of references is included. (R.V.J.)

50917 MULTIPLE PAGETOID EPITHELIOMA APPEARING IN AN AREA FORMERLY STRONGLY IRRADIATED BY X RAYS. Colomb, D.; David, D. Bull. Soc. Fr. Dermatol. Syphiligr., 75: 525-6(1968). (In French).

The possibility of radioinduced tumor is suggested in the case history of a 62-yr-old woman that is reported. She presented a multiple pagetoid epithelioma in the lumbosacral region 44 yr after receiving a large number (32) of x-ray treatments of this region for lumbalgia with sciatica. About 22 yr after irradiation, at the age of 42, a pigmented plaque arose in the left lumbar region and progressively increased in size. This plaque gradually became surrounded by other smaller lesions, and at age 50 the larger lesion was diagnosed as an epithelioma and treated by radiotherapy. Twelve yr later the diagnosis of radiodermatitis was made, and numerous pruritic lesions were noted. Histologically, a superficial, basocellular, pagetoid epithelioma was confirmed. The 2 largest lesions were removed by electrodissection, and scarring followed normally. The marked cutaneous fragility resulting from radiotherapy carried out many years earlier is commented upon. (BBB)

50918 HIGH-DOSE RADIOTHERAPY FOR CARCINOMA OF THE CERVIX: METHOD AND RESULTS. Kline, Joyce C.; Schultz, Alwin E.; Vermund, Halvor; Peckham, Ben M. (Univ. of Wisconsin, Madison). Amer. J. Obstet. Gynecol., 104: 479-84(June 15, 1969).

A method of radiotherapy of invasive carcinoma of the cervix has been devised utilizing rectal and bladder tolerance as the limiting factor for total central dose. The resulting mg-hr and paracervical rad doses were high, especially when intracavitary therapy was emphasized. The survival and other statistics on 450 patients treated between 1961 and 1967 showed that no striking improvement resulted from the increased doses and that a substantial number of complications developed. The high-dose therapy used differed from all previous techniques in that no limits were set upon doses to the parametrial area (point A). Bladder and rectal tolerance was thought to be 7000 to 8000 rad over a 6- to 7-week period. Emphasis was placed on the intracavitary phase, with supplemental external radiotherapy to the lateral parametrial areas. A wide range of mg/hr doses, from less than 6000 to about 16,000 was used. The mean was 10,463 mg/hr. The external therapy was designed to deliver 6000 rad to the central pelvis by a 4-port technique (anterior, posterior, right, and left lateral) in about 6 weeks. Both ^{60}Co and 1-MeV x rays were used. Results of this high-dose therapy were not very good. The original hypothesis that an improved survival rate in carcinoma of the cervix would result from sharply elevating radiation levels exclusive of the bladder and rectum was shown to be incorrect. An analysis of dose delivered and complications sustained form the basis for a new direction in therapy. (BBB)

50919 EFFECTS OF MICROWAVE RADIATION ON TISSUE: A SURVEY OF BASIC MECHANISMS. Schwan, H. P. (Univ. of Pennsylvania, Philadelphia). Non-Ioniz. Radiat., 1: 23-31 (June 1969).

Present knowledge about the effects of microwaves on man, tissues, and biological systems at large is discussed. The following topics are dealt with: absorption characteristics and electrical properties of tissues; effects of reflections at boundaries between various tissues; relative absorption cross section of man; field induced force effects on small particles in general and cells and macromolecules in particular. Thermal effects are distinguished from nonthermal effects. While strong interactions of microwaves with biological material are largely understood, weak interactions are uncertain. Present radiation safety standards are based on present day knowledge of strong interactions and pertinent considerations are indicated. (auth) (UK)

50920 CHANGES OF THE DNA CONTENT IN CELLS FROM CERVICAL CANCER UNDER CYTOSTATIC AND RADIATION THERAPY. Holzner, J. Heinrich; Golob, Erich (Univ. of Vienna). Acta Cytol., 12: 473-7(Nov.-Dec. 1968).

In 21 cases of Stages II and III cervical carcinoma treated by triaziquone (Trenimon) followed by Ra and telecobalt γ irradia-

tion, determinations were made of whether the qualitative change in the DNA content of stem line tumor cell types was caused by the influence of the cytostatic drug or of ionizing radiation; if numerical increases or decreases of the stem line cell type occur; and the relation of DNA content to the appearance of giant nuclei. No changes occurred in the stem line tumor cells as a result of the cytostatic drug or irradiation, but a numerical decrease of tumor cells representing the stem line occurred after irradiation. This decrease reached 50% in some cases. Metaphases did not seem to be influenced; their DNA content was about twice as high as that of the stem line cells. In all cases nuclei with a DNA content more than three times higher than the values of the stem line cells increased after irradiation. In one case nuclei with increased DNA content also occurred after cytostatic treatment. In some cases such nuclei represented as much as 21% of the total tumor cell population. They were not, however, sufficiently representative to allow a diagnosis based on the nuclear enlargement, because only one part of the enlarged nuclei had a correspondingly higher DNA content. There was no correlation between the increase of nuclear volume and increase in DNA content. When DNA values increased, no mathematical correlation to the DNA values of the stem line cells could be found. (BBB)

50921 NUCLEOLAR COEFFICIENT OF LYMPHOCYTES OF URANIUM MINERS. Novakova, Ella (Zavodni Ustar Narodniho Zdravi Uranoveho Prumyslu, Pribram, Czech.). Vnitr. Lek., 14: 256-60 (Mar. 1968). (In Czech).

The nucleolar coefficient of lymphocytes was studied in 34 healthy subjects without a history of occupational radiation exposure and in 73 healthy persons exposed regularly and for long periods to low doses of ionizing radiation. It was not possible to establish a statistically significant difference in the mean values of the nucleolar coefficient by comparison of the results for the two groups. It was concluded that the mean value of the nucleolar coefficient of lymphocytes in a population of miners does not, by itself, constitute an indication of exposure of this population to small doses of ionizing radiation. The mean value of the nucleolar coefficient in the unexposed control group was 1.115 ± 0.026 compared to 1.139 ± 0.035 in the exposed group. In the exposed group, the average values for those exposed less than 10 yr and greater than 10 yr were 1.138 and 1.140, respectively. (BBB)

50922 EXTRACORPOREAL IRRADIATION OF THE BLOOD WITH ULTRAVIOLET RAYS. Binet, J. L.; Villeneuve, B.; van Rapenbusch, R.; Mignon, Francoise; Becard, Renee; Vaugier, G.; Bernard, Jean (Hopital Saint-Louis, Paris). Nouv. Rev. Franc. Hematol., 8: 733-44 (Sept.-Oct. 1968). (In French).

An in vitro technique for the destruction of blood lymphocytes using uv irradiation, without significant modification of granulocytes, red cells, or platelets, was used for extracorporeal irradiation of the blood (ECIB). The apparatus provided for six unfiltered mercury vapor lamps giving a uv wavelength of 254 mμ with a dose rate of 15,000 erg/sec. The blood traversed the apparatus in a quartz tube 3 mm thick, with a total capacity of 120 ml. The quartz coil was connected to an arterio-venous shunt. Irradiation time and volume irradiated were controlled by an electronic pump. In 20 goats without blood disease, a single 6-hr irradiation with an hourly flow of 3 to 6 liter, and an irradiation time of 1 to 3 min, produced a peripheral lymphopenia of variable degree duration. Lymphopenia was also observed in four patients with chronic lymphocytic leukemia treated with this apparatus. (BBB)

50923 ALGODYSTROPHY OF CHEMOTHERAPEUTIC ORIGIN. PSEUDORHEUMATISM DUE TO ISONIAZID, ETHIONAMIDE, PHENOBARBITAL, AND RADIOACTIVE IODINE. Lequesne, M. (Hopital Lariboisiere, Paris). Sem. Hop. Paris, 43: 2581-95 (Oct. 14, 1967). (In French).

The possibility that radioiodine and several other therapeutic substances may cause pain and swelling in hands, shoulders, and/or feet is examined. A survey of 600 patients who were treated with ^{131}I showed 11 cases of capsulitis of the shoulder and 3 with the hand-shoulder syndrome. Whether the patients pre-existing hyperthyroidism for which ^{131}I was given can be implicated is discussed, and it is concluded that ^{131}I is at least partially responsible. This is seen by the rapid onset of the so-called algodystrophy after ^{131}I injection, and the fact that in a few cases thyrotoxicosis was not present prior to radioiodine treatment. It appears then that ^{131}I alone can be incriminated in certain cases. Isoniazid and especially the combination of isoniazid and ethionamide (cycloserine) or phenobarbitone may also cause in a small number of patients a shoulder-hand syndrome which is usually atypical; the term algodystrophy is therefore used. Seven cases are reported, 3 due to antituberculous drugs and 3 due to phenobarbitone and 1 due to both, and the reported cases are reviewed. Compared with the classical shoulder-hand syndrome, the atypical characteristics are: the fact that it is frequently bilateral (usually in 50% to 80% of cases, in this series 100% of cases); multiple joint involvement, especially with isoniazid-ethionamide in association; sometimes the shoulders or hands alone are involved; frequency of associated palmar fibrous nodules, in this series, 6 cases out of 7; absence of osteoporosis; absence in this series of the early pain and edema in the hand; the diagnosis is probably subacute capsulitis. The syndrome resolved favorably within a few months in spite of the continuation of isoniazid or phenobarbitone treatment (ethionamide had to be stopped). The history often revealed other contributory factors. (BBB)

50924 BRAIN EDEMA. Proceedings of the Symposium, September 11–13, 1965, Vienna. Klatzo, Igor; Seitelberger, Franz (eds.). New York, Springer-Verlag New York Inc., 1967. 715p. $28.50. (CONF-650997).

The proceedings of a symposium on brain edema held in Vienna in 1965 are presented. The 48 papers included are grouped into four general categories: Clinical Aspects of Brain Edema; Brain Edema in Human Pathology; Fluid Compartments, Electrolytes, and Transport Mechanisms; and Experimental Studies on Brain Edema. A round table discussion is presented at the end of the proceedings. (E.R.B.)

Radiation Effects on Plants

Refer also to abstracts 50337, 50356, 50399, 50405, 50411, 50413, 50414, 50419, 50420, 50422, 50425, 50426, 50429–50431, 50433–50443, 50445, 50450, 50823, 50844, 50942, and 50952.

50925 (NYO-2043-195) APPLICATION OF NUCLEAR ENERGY TO AGRICULTURE. Triennial Report, July 1, 1966–June 30, 1969. Moh, Carl C. (Inter-American Inst. of Agricultural Sciences, Turrialba (Costa Rica)). Contract AT(30-1)-2043. 196p. Dep. CFSTI.

Separate abstracts were prepared on seven of the 17 papers in this report. Six of the other papers discuss studies in soil chemistry; three of them deal with the control of agricultural insect pests; and one presents a list of induced bean mutants and their genetic behavior. (E.R.B.)

For abstracts of individual papers see: 50277, 50411–50414, 50926, and 50963.

50926 (NYO-2043-195, pp 1-7) RADIOSENSITIVITY OF TROPICAL PLANT SPECIES. Moh, C. C.; Nanne, H. (Inter-American Inst. of Agricultural Sciences, Turrialba (Costa Rica)).

The maximum daily dose at which plants can survive for a lengthy period or until their natural death was used as the criterion for the γ-radiosensitivity of vegetatively propagated species of tropical plants and the maximum daily dose at which the plants can produce seeds to complete their life cycle was used as the criterion for the radiosensitivity of seed propagated species. These two criteria would give information on the critical dose level at which a plant species could maintain its continuity in a plant community in case of heavy radioactive fallout. Plants were arranged radially from a ^{137}Cs γ source and exposed to a daily chronic radiation dose ranging from 500 to 5R. Data on the radiosensitivity of gymnosperms include Pinus montezumae, Sequoia sempervirens, Taxodium distichum, Cycas revoluta, and Zamia skinneri. In general, the gymnosperms were found to be a very radiosensitive group of plants and none of the species tested could survive a daily dose of greater than 30 R after more than a year of exposure. Representative species of the important angiosperm plant families were studied. Data on the γ-radiosensitivity of Leguminosae include Canavalia gladiata, Dolichis lablab (Chimbolo verde); Leucaena glauca; and Tephrosia vogelli and data on the γ-radiosensitivity of root crops include Ipomoea batatas and Manihot esculenta. Data on the γ-radiosensitivity of tropical fruit species include Anthocarpus integra, Bixa ovellana, Chrysophyllum cainito, Citrus grandis, Eugenia jambos, Guilielma utilis, Litchi chinensis, Macadamia integrifolia, Musa sapientum, Psidium friedrichsthalianum, Psidium guajava, and Psidium guineense. (C.H.)

50927 (SGAE-LA-1/1969) ACTION OF IONIZING RADIATION ON BARLEY. Szilvinyi, A. v. (Oesterreichische Studiengesellschaft fuer Atomenergie, Seibersdorf. Landwirtschaftliche Forschungsabt.). [1969]. 28p. (In German). Dep. CFSTI (U. S. Sales Only).

Polyphenol content of barley depends on strain as well as on environment. Close correlations were established between protein and polyphenol content; thus, both factors are influenced by the

same environmental conditions. Gamma doses around 10 or 20 krad enhance the phenol content of barley. At higher doses, exceeding 1000 krad, the content drops to or below original values. Similarly, tyrosinase activity depends on strain and environment. Content of protein and tyrosinase activity are correlated positively; whereas, no correlation exists between polyphenol content and tyrosinase activity. Cobalt-60 γ radiation, at low doses, enhances tyrosinase activity; at high doses, activity is decreased. (H.B.G.)

50928 (STI/DOC–10/76) NEUTRON IRRADIATION OF SEEDS. Technical Reports Series No. 76. Report of a Study-Group Meeting on Co-ordination of Research in the Use of Neutrons in Seed Irradiation, Vienna, 25–29 July 1966 and of a Working Group Meeting on Recommendations for a Neutron Seed Irradiation Programme, Vienna, 12–16 December 1966. (International Atomic Energy Agency, Vienna (Austria)). 1967. 119p. (CONF-660703; CONF-661218). IAEA $2.50. Dep.

Separate abstracts were prepared for seven papers presented at the conference. An additional 18 papers were presented on v ous aspects of neutron irradiation of seeds. (H.L.W.)

For abstracts of individual papers see: 50439–50441, 50937, and 52423–52425.

50929 ISOLATION OF A TRYPTOPHAN-REQUIRING MUTANT OF OPHIOSTOMA MULTIANNULATUM. Zetterberg, Goesta; Jonsson, Ulla; Karlsson, Margareta (Uppsala Univ.). Hereditas, 62: 97-104(1969).

After uv irradiation cells of Ophiostoma multiannulatum were plated on minimal medium plus the amino acid required by the mutant type being isolated. Colonies formed on this substrate by cells surviving the mutagenic treatment were transferred to minimal medium. Transfers that did not grow on minimal medium were suspected mutants and were isolated for further tests. Extensive experiments yielded only one tryptophan-requiring strain, that is characterized here. The uv source was a low-pressure mercury lamp (Philips TUV 15) and the dose used killed 97 to 99.9% of the irradiated cells. The tryptophan-requiring mutant was isolated from a morphological type that permitted replica plating. The mutant represented a new type of auxotroph in Ophiostoma. It has a block in the synthetic pathway between anthranilic acid and indole. The growth of the mutant is inhibited on complete medium. Mutation to requirement for tryptophan is almost always lethal if the cell in which the mutation has occurred is plated on complete medium. However, on minimal medium plus tryptophan the mutant survives. What component in the complete medium is inhibiting on the mutant was not ascertained. (BBB)

50930 THE INFLUENCE OF ULTRAVIOLET RADIATION ON THE GROWTH AND SPORULATION OF CERTAIN SPECIES OF FUNGI. Savulescu, Olga; Tudosescu, Veronica (Univ., Bucharest). Rev. Roum. Biol., Ser. Bot., 13: No. 1-2, 141-4 (1968). (In French).

The sterilizing effect of uv radiation was widely used, especially in bacteriology; in this connection several studies were carried out on the sporulation and the resistance of the spores of irradiated fungi. This problem was further examined by studying under laboratory conditions the effect of uv radiation on the growth of the mycelium and sporulation of fungi that cause mildew. Aspergillus niger v. Tiegh., Botrytis cinerea Pers., Trichothecium roseum Lk. and Fusarium sp. exhibited varying degrees of sensitivity toward uv radiation doses, applied for periods ranging from 15 min to 2 hr. Botrytis cinerea and Trichothecium roseum were more and Aspergillus niger and Fusarium were less sensitive toward the radiation. A single application of the radiation for a period of 15 to 30 min stimulated the growth of the mycelium of Aspergillus niger and Botrytis cinerea, while longer exposures from 1 to 2 hr slowed down the growth rate of the mycelium of Aspergillus niger and Fusarium sp. and caused the loss of vitality of the mycelium of the other two mushrooms. (TTT)

50931 EFFECTS OF IRRADIATION UPON STARCH FORMATION AND STARCH HYDROLYSIS IN TOMATO MICROSPORES. De Nettancourt, Dreux; Eriksson, Goesta (EURATOM–ITAL, Wageningen, Netherlands. Royal Coll. of Forestry, Stockholm). Hereditas, 60: 167-76(1968).

With the aim of detecting pollen markers in Lycopersicum esculentum, an analysis was made of the effects of irradiation upon starch formation and starch hydrolysis in tomato microspores. Bud irradiation tended to inhibit starch hydrolysis in the microspores. For this criterium the period of greater sensitivity was observed to take place shortly prior to pollen mitosis and before the beginning of starch formation. Among 806 M_1 plants that were irradiated at the seed stage, pollen grains from one individual were found to segregate in a 1 to 1.3 ratio for presence of starch in the open flower. Starchy pollen grains are sterile but it was assumed that the mutation can be transmitted by the female germplasm and would be recovered in the next generation. Scoring tests were also conducted on buds that were irradiated at the meiotic stage and harvested one day after the initiation of starch synthesis. It was demonstrated that tomato pollen mutants that resemble the waxy pollen grains in maize and barley can be induced. (auth)

50932 WHAT MUST ONE THINK OF GROWTH STIMULATION BY GAMMA IRRADIATION OF SEEDS AND TUBERCLES BEFORE PLANTING? Silvy, Andre (Centre d'Etudes Nucleaires, Cadarache, France). Cah. Ing. Agron., No. 218, 9-15(Aug.–Sept. 1967). (In French).

The effect of γ radiation on the growth of plants was tested on eight vegetable species—carrots, radish, spinach, potatoes, tomatoes, barley, rice, and corn. The seeds were irradiated and the development of the plants through harvest was followed and analyzed. The effect of the irradiation on germination, growth of young plants, adult plant growth, development, and yield at maturity was determined. The results indicated that the stimulating effects of irradiation on the seeds are not important enough that this technique should be adopted in agriculture. (J.S.R.)

50933 A RADIOBIOLOGICAL STUDY IN THE STAMEN HAIRS OF TRADESCANTIA BLOSSFELDIANA MILDBR. Ichikawa, Sadao (Kyoto Univ.). Seiken Jiho, No. 20, 35-45(Dec. 1968).

The loss of reproductive integrity and the occurrence of morphologically abnormal cells following exposure of potted plants with young inflourescences to 165 to 1391 R x-radiation were studied in the stamen hairs of Tradescantia blossfeldiana, a twelve-ploid species. The x ray exposures impaired the normal reproductive ability of the terminal cells of the stamen hairs, resulting in reduction in cell number per hair. The D_0 value obtained from the data of stunted hairs was 767 R, and that from postirradiation cell increase in hairs was 984 R. It was evident that x rays caused various degrees of loss of reproductive integrity, i.e., from complete loss to slight partial loss. Various morphological abnormalities such as giant, dwarf, and misshapen cells were induced at the hair apices. From the frequencies of the hairs without such morphologically abnormal tips, a D_0 value of 776 R was obtained. An evident positive correlation was found between the occurrence of these morphological abnormalities and the loss of reproductive integrity. (auth)

50934 PRODUCTION OF HIGH QUALITY AGAR BY GAMMA IRRADIATION OF SEAWEEDS. Doshi, Y. A.; Talrejs, S. T.; Rao, P. S. (Central Salt and Marine Chemicals Research Inst., Bhavnagar, India). Indian J. Technol., 6: 275-7(Sept. 1968).

Agar obtained from dry seaweeds exposed to ^{60}Co γ radiation at relatively low doses (0.5 to 3.0×10^{18} eV/g) had 1.2 to 2.5 times higher gel strength than agar obtained from unirradiated seaweeds. The gel strength did not deteriorate on storage in sealed or open tubes. The gel strength increased with increases in radiation dose up to a critical dose; this dose differed from species to species. The increase in gel strength is attributed to the action of radiation on the sulfate ester moiety of the agar molecule. A marked diminution in the sulfate content of agar on irradiation was evident; a steady value was attained beyond a critical dose, which corresponded to the optimum dose for maximum gel strength. Thus, in Gracilaria milardetii the sulfate content in agar diminished from 1.4 to 0.8% after an irradiation dose of 2.9×10^{18} eV/g. The total sulfate content in all the samples studied decreased on irradiation, the decrease being more rapid in the case of Hypnea musciformis and G. milardetii. The loss in sulfate content can be partly attributed to the production of hydrogen sulfide in the system. The amount of hydrogen sulfide thus formed varied between 0.6 and 1.7% for seaweeds and between 0.14 and 0.15% for agar samples. (BBB)

50935 RADIATION STUDIES ON VEGETATIVE DICTYOSTELIUM DISCOIDEUM CELLS. Freim, John Oliver Jr. University Park, Pa., Pennsylvania State Univ., 1968. 131p. Thesis.

The effects of gamma and ultraviolet radiation on Dicytostelium discoideum were studied. The slime molds were relatively radiation resistant. Survival was measured by the ability of cells to form plaques on bacterial lawns. Survival curves had a shoulder and became exponential at higher doses. Irradiated survivors had a division delay followed by a reduced growth rate. Neither acriflavine nor liquid holding had any effect on survival of uv-irradiated cells, but caffeine did sensitize cells to irradiation, photoreactivation was ineffective on irradiated cells unless they were also treated with caffeine. Deoxyribonucleic acid synthesis was blocked after uv irradiation and ribonucleic acid and protein synthesis were also retarded but to a lesser degree. Full synthesis of all three macromolecules was later restored. The action spectra for both growth and division delay probably implicated a nucleoprotein. (Diss. Abstr.) (TSS)

50936 EFFECT OF GAMMA RADIATION AND ETHYL METHANE SULFONATE ON SEEDS, CUTTINGS, AND POLLEN IN GRAPES. Das, P. K.; Mukherjee, S. K. (Indian Agricultural Research Inst., Delhi). Indian J. Genet. Plant Breed., 28: 347-51(Nov. 1968).

Wet seeds of 4 varieties of grape, Bharat Early, Bhokri, Pusa Seedless, and Bangalore Blue, were exposed to ^{60}Co γ rays for doses of 5 to 30 kR. Cuttings were given 1 to 10 kR, and pollen material (in form of mature inflorescence) was given exposures ranging from 5 to 200 kR. Seeds were also treated with 0.1 to 0.5% EMS (ethyl methane sulfonate). There was a gradual decrease in seed germination with increase in exposure of seeds to irradiation or concentration of the chemical. The area of cotyledonary leaves, height, and number of leaves of seedlings were reduced considerably. Some albino seedlings were produced in Bharat Early only. EMS was less injurious as compared to γ rays and hence gave higher germination and survival. EMS also produced fewer mitotic abnormalities. However, chromosome stickiness was produced only in EMS but not in radiation treatments. Dormant cuttings of three varieties had an LD_{99} between 2 and 4 kR, and 10 kR was lethal for all varieties. With increase in exposure of cuttings there was a decrease in length and diameter of cane, indicating the inhibitory effect of radiation on cell division and cell proliferation. The sprouting of treated plants in the second year after irradiation was delayed. Even 200 kR did not much impair the in vitro pollen germination. Though irradiated pollen with higher exposures could not be used for pollination studies, good fruit-set was obtained with exposures up to 100 kR. It is likely that exposure to effect 50% reduction in fruit-set may be considerably lower than the exposure needed to cause 50% reduction in in vitro pollen germination. (BBE) (TSS)

50937 RECOMMENDED STANDARD PROCEDURES FOR IRRADIATING, CULTIVATING AND MEASURING CEREAL SEEDS TO DETERMINE THE EFFECTS OF NEUTRON IRRADIATION IN THE NEUTRON-SEED-IRRADIATION PROGRAMME. Konzak, C. F.; Mikaelsen, K.; Sigurbjoernsson, B.; Burtscher, A. pp 103-7 of Neutron Irradiation of Seeds. Vienna, International Atomic Energy Agency, 1967.

From Panel Meeting on the Use of Neutrons in Seed Irradiation, Vienna, Austria.

From Meeting on Recommendations for a Neutron Seed Irradiation Programme, Vienna, Austria. See STI/DOC-10/76; CONF-660703; CONF-661218.

The standard seed recommended is a hull-less variety of barley. For irradiation seeds are placed in polyethylene vials and irradiation is carried out in a Standard Neutron Seed Irradiation Facility. Diagrams are presented for the experimental design. A new technique for culturing seedlings from mutagen-treated barley seeds is described. Equipment and procedures are also described for methods of planting and analysis of seedling-growth data. (H.L.W.)

50938 ORIGINAL WATER-SOLUBLE RADIOTOXINS AS A FACTOR INDUCING THE DEVELOPMENT OF PHAGE IN ESCHERICHIA COLI K-12 (λ). Yurov, S. S.; Veksler, A. M.; Kuzin, A. M.; Merkulov, A. S. (Inst. of Biological Physics, Moscow). Dokl. Akad. Nauk SSSR, 184: 969-71(Feb. 1, 1969). (In Russian)

Water soluble radiotoxins, formed in irradiated plants, as factors contributing to development of lambda phages in Escherichia coli K-12 were studied using radiotoxins extracted from 4-day sprouts of Sterling type cotton seed irradiated with 40 Ci doses of γ radiation. The sprouts were homogenized in 50% ethanol (1:10) acidified with HCl. Data obtained showed about 1.8 to 2.2 times increase of lysogenic activity in irradiated plants as compared to the control ones. (R.V.J.)

50939 DESTRUCTIVE EFFECT OF VAPOUR HEATING AND γ-RAY RADIATION ON THE GERMINATION OF PAPAVER SOMNIFERUM L. AND CANNABIS SATIVA L. 2. Fujita, Sanaenosuke; Kawatani, Toyohiko (National Inst. of Hygenic Sciences, Tokyo). Eisei Shinkenjo Hokoku, No. 86, 68-74(Dec. 1968). (In Japanese).

With a view to studying the influence of γ-ray radiation on the germination of Papaver somniferum L. and Cannabis sativa L., especially whether or not the period after treatment up to the sowing has an accelerative effect on the destruction of the germinating power, six germination experiments ($G_2 \sim G_7$), following the part I (G_1), from the 2nd sowing (20 days after treatment) to the 7th (109 days after treatment), at intervals of about 20 days, were made, with two strains, domestic and foreign, in the former plant, and one domestic strain in the latter. In the case of P. somniferum, in each of $G_2 \sim G_7$, in general (strain as random model), the effect of the strain P and that of radiation R were both very highly significant, as in the case of G_1, germinating power being destroyed at doses more than 80,000 R, the interaction of the strain and the treatment P × R was also very highly significant, the effect of the period after treatment G was significant, there being no significant difference among the germination percents of $G_1 \sim G_4$, however, in G_7 germination percent having lowered. The interaction of the period after treatment and the strain G × P was very highly significant. The interaction of the period after treatment and the radiation G × R was not significant. Therefore, it was by no means recognized that the period after treatment has some special effect, accelerative or recovering, on the destruction of the germinating power. In the case C. sativa, in each of $G_2 \sim G_7$ (strain as finite model), the effect of the treatment R was very highly significant, there, on an average, being no significant difference in the germination power between the doses up to R_4 (40,000 R) and R_9 (control), however, at the doses more than R_5 (80,000 R) germinating power gradually having lowered, and finally at the dose R_{10} (2,560,000 R) it having been lost. The effect of the period after treatment G was also very highly significant, there, on an average, being no significant difference in the germinating power between the treatments up to G_4 (sown 48 days after treatment) and G_1 (sown just after treatment), however from G_5 (sown 70 days after treatment) the germinating power having begun to decrease. The interaction of the period after treatment and the radiation G × R was also very highly significant. It was recognized that the period after treatment has the more accelerative effect on the destruction of the germinating power, when treated with the stronger doses of radiation. (NSA of Japan)

50940 GENETICHESKIE I FIZIOLOGICHESKIE EFFEKTY DEISTVIYA UL'TRAFIOLETOVOI RADIATSII NA VYSSHIE RASTENIYA. (Genetic and Physiological Effects of Ultraviolet Radiation on Higher Plants). Dubrov, A. P. Moscow, Izdatel'stvo Nauka, 1968. 251p.

The role of uv radiation in the activities of higher plants was investigated. Photobiological investigations on large amounts of local and foreign material showed the peculiarity of genetic and physiological actions of uv radiation. The molecular bases of the processes of damage and restoration are changes in biochemical functions. The value of uv radiation and photoreactivation in the evolution of vegetable varieties, and the practical application of uv radiation in the rural economy are considered. The book was designed for biologists of different specialties directly or indirectly related to the study of the biological effects of uv radiation on plants. (auth)

Radiation Effects on Microorganisms

Refer also to abstracts 49822, 50333, 50335, 50339, 50340, 50368, 50385, 50409, 50421, 50423, 50428, 50432, 50449, 50802, 50823, 50832, 50844, 50957, 50966, and 50971.

50941 MULTIPLICITY REACTIVATION OF ANIMAL VIRUSES. Sharp, D. Gordon (Univ. of North Carolina, Chapel Hill). Progr. Med. Virol., 10: 64-109(1968).

Multiplicity reactivation (MR) of radiation-damaged animal viruses is reviewed, and examples of results with various viruses are considered. Influenza virus of both types A and B partially inactivated by uv rays may regain their capacity to propagate in the allantoic membrane of the chick embryo. In using such irradiated preparations as inocula for growth experiments it was shown that the development of hemagglutinins as well as of infectivity proceeded at rates resembling those noted with more than 10 times the amount of infective virus actually found in the irradiated seed. In samples subjected to prolonged irradiation or heating, the capacity for reactivation was lost. Likewise, an irradiated preparation capable of reactivation in the allantoic membrane could not be diluted more than 30-fold and still clearly produce this phenomenon. Thus reactivation was obtained only when one host cell adsorbed more than one noninfective virus particle but not upon adsorption of a single particle. Most studies have used uv light from a low pressure mercury discharge lamp giving most of its output in the resonance emission line at 2537 Å wavelength. Inactivation of the virus proceeds in a log-linear fashion with dose to a survival level of somewhat less than 10^{-5}. Ionizing radiations were used in some studies. Soft x-rays (50 KV) inactivated coliphages without evidence of MR. Irradiation of bacteria-phage complexes immediately after attachment would induce MR but prior to attachment the x rays appeared to damage the injection mechanism. Vaccinia virus treated with these soft x rays gave evidence of MR indistinguishable from that found with nitrogen mustard or uv rays. Exposure of the viruses to ^{137}Cs γ rays gave the same result. In aggregated form, these irradiated virus particles produced 50 to 100 times more plaques than when they were dispersed by ultrasonication. The mechanism of MR is speculated upon. One mechanism that was proposed for MR with irradiated virus requires a single molecule of derepressor protein. This molecule, according to this hypothesis, is the determining factor in inactivation of

the virus by radiation. The one-hit nature of the process leads to the hypothesis of only one molecule. This molecule, if it survives irradiation, will be released when the virus particle is reduced to a core during the preliminary uncoating process within the cell. However, the only scheme so far advanced for MR that seems consistent with the experimental data is one that involves genetic recombination. (BBB)

50942 EVALUATION OF THE RELATIONSHIP BETWEEN ULTRAVIOLET SENSITIVITY AND CROSSING-OVER IN BACTERIA AND FUNGI. Tuveson, R. W. (Univ. of Illinois, Urbana). Amer. Natur., 103: 23-30(Jan.-Feb. 1969).

Evidence indicating that factors controlling radiosensitivity in bacteria and fungi might overlap those factors controlling functions involved in the exchange of chromosome parts (crossing-over) is reviewed. The mechanism by which linked genes are recombined is discussed in terms of a model in which the chromosome is viewed as functionally equivalent to a DNA duplex. Crossing-over is initiated when the chromosome opens up (at the end of a polaron), dissociation of the DNA duplex occurs, and the synthesis of new nucleotide chains takes place, resulting, finally, in the formation of hybrid regions in the DNA. Following formation of the hybrid molecule by complementary base pairing, the unpaired regions break down (by the action of endonucleases). This model predicts the involvement of repair-like enzymes throughout the process of crossing-over. Systems of enzymes known to be capable of repairing radiation-damaged DNA might overlap those systems postulated to be involved in crossing-over. Since the hybrid DNA-repair system model for crossing-over was proposed 3 yr ago, evidence has accumulated which supports its essential features. Evidence in support of the model from studies in Escherichia coli is cited. It was demonstrated that certain mutants selected for x-ray sensitivity were also defective in recombination. It is concluded that a reduction in recombinant frequencies in bacteria or defective meiosis in fungi as a pleiotropic effect of certain genes conferring radiosensitivity cannot be taken as unequivocal evidence that functions concerned with crossing-over are defective. It is suggested that the isolation of mutants defective for functions concerned with the exchange of chromosome parts has not as yet been accomplished in either fungi or bacteria. Probably more than one system exists for the repair of mutagen damage in both bacteria and fungi. Assuming a multiplicity of repair systems, it is likely that the mutants isolated to date represent defects in repair systems, the enzymes of which do not overlap those involved in crossing-over. (BBB)

50943 VARIABILITY IN THE SURVIVAL OF ESCHERICHIA COLI B, IRRADIATED BY γ-RAYS AND α-PARTICLES. Myasnik, M. N.; Korogodin, V. I.; Petin, V. G.; Morozov, I. I. Dokl. Akad. Nauk SSSR, 185: 932-4(Apr. 1, 1969). (In Russian).

The survival of Escherichia coli B irradiated with γ rays or α particles from ^{210}Po was determined at the same time by growing the cells under the same conditions before and after irradiation. Eighteen-hour cultures grown on wort agar or on fish agar were irradiated as a monolayer. Control and irradiated cells were placed in Petri dishes, and were incubated at 37 and 42°C. The survival was determined by counting the macrocolonies after 24-hr incubation. The survival of cells grown on wort agar before irradiation with subsequent culturing on fish agar at 42°C is significantly higher than at 37°C irrespective of whether the bacteria are irradiated with γ rays of α particles. Hence the increased survival at 42°C is determined not by the type of radiation but by the conditions under which the cells were raised before irradiation. It is hypothesized that the filamentous-type of E. coli that are often nonviable are not encountered as often at 42°C as they are at 37°C. Growing of cells on wort agar before irradiation significantly increases the frequency of filament formation in the postradiation period. Thus the variation in survival of E. coli B at various temperatures of postradiation culturing is associated with the frequency of filament formation and is determined by the conditions of raising the cells before and after irradiation, and not by the type of radiation. (TTT)

50944 THE SURVIVAL OF BACTERIAL CELLS PULSE-IRRADIATED UNDER VARIOUS OXYGEN CONCENTRATIONS. Epp, Edward R. (Sloan-Kettering Inst. for Cancer Research, New York). Ann. N. Y. Acad. Sci., 161: 337-40(July 3, 1969).

From Conference on High Energy Radiation Therapy Dosimetry, New York. See CONF-670665.

The survival of bacterial cells that were pulse-irradiated at various oxygen concentrations was studied. The colony-forming ability of Escherichia coli B/r irradiated with electron pulses over a range of oxygen concentrations was measured and compared with survival observed for x rays administered at a relatively low dose rate. If the break-point dose is plotted as a function of oxygen concentration, a linear relation is observed supporting the contention that evidently too much oxygen was initially present in the bacteria to be removed entirely by radio-induced chemical reactions. (E.R.B.)

50945 COLICINE I FACTORS DEFECTIVE FOR COLICINE PRODUCTION. Howarth-Thompson, Sheila (Otago Univ., Dunedin, N. Z.). Proc. Univ. Otago Med. Sch., 46: 85-7(Oct. 1968).

Radioresistance of ColI factor mutants was tested. Colicine factor colIb-P9 confers upon the bacteria containing it the potentiality to produce colicine I. It also confers fertility by initiating cell conjugation, accomplishing thereby its own transmission between cells, the efficient transfer of other plasmids that are self-transmissible only at very low frequency or not at all, e.g., colE1, and the transfer of chromosomal genes. Thirdly, it changes the uv response of the cells. To investigate the genetic structure of the colicine factor, colicinogenic bacteria carrying colIb-P9 were treated with N-methyl-N-nitroso-N'-nitroguanidine (NG) to induce mutations in the factor. Five colicine-negative cell lines were found after NG treatment of tryD-I(colIb-P9). The uv response and transmissibility tests showed that cell lines 1, 2, 3, and 12 retained colI factors. The character used to detect transmission of factors from 1, 2, and 3 was uv resistance. Furthermore, all 4 factors promoted the transfer of ColE1 and of chromosomal genes. Lines 21 and 23, on the other hand, were like noncolicinogenic strains in their uv response and were not fertile. Mutations in ColI factors carried by cell lines 1, 2, and 3 either destroyed the function of the structural gene for colicine, or deleted the gene entirely. In the factor of cell line 12 the structural gene is clearly still present and mutation in this gene, or elsewhere in the genome, affected the potency of the colicine, or its amount. (BBB)

50946 RESCUE OF ROUS SARCOMA VIRUS FROM VIROGENIC MAMMALIAN CELLS ASSOCIATED WITH CHICKEN CELLS AND TREATED WITH SENDAI VIRUS. Svoboda, J. (Inst. of Experimental Biology and Genetics, Prague); Dourmashkin, R. J. Gen. Virol., 4: 523-9(June 1969).

An assay system for rescue of Rous sarcoma virus (RSV) from virogenic mammalian cells is described. It is based on the enumeration of RSV foci in mixed culture of uv-irradiated virogenic Chinese hamster cells transformed by RSV (RSCh), and nonirradiated chick embryo cells treated with Sendai virus. This assay was used for the quantitative estimation of the proportion of virogenic cells giving rise to RSV production in mixed cultures. In addition, data are presented concerning the relation between RSV rescue and heterokaryon formation, electron microscopy of cells treated with Sendai virus, and absence of mature RSV particles in RSCh cells. When the ratio of RSCh to chick fibroblasts was 1:64, or less, the amount of rescued Rous sarcoma virus decreased proportionately with the dilution of RSCh cells. Over this range, treatment with uv-inactivated Sendai virus increased rescue of Rous sarcoma virus 100 times as compared with untreated cell mixtures. No infectious virus was found in tissue culture fluid or extracts from RSCh cells when both were incubated with chick embryo cells that afterwards underwent treatment with Sendai virus. Using different conditions of incubation after treatment of cell mixtures with Sendai virus, a varying frequency of heterokaryon formation was obtained. There was good correlation between heterokaryon formation and rescue of Rous sarcoma virus measured in parallel cultures. (BBB)

50947 EFFECT OF THE PHOTON RADIATION IN THE MICROBICIDAL EFFECT OF TRANSIENT ELECTRIC ARCS IN AQUEOUS SYSTEMS. Edebo, L. (Univ. of Uppsala). J. Gen. Microbiol., 50: 261-70(Feb. 1968).

The effects of uv radiation (2537 Å) and of underwater electric arc radiation were compared in a uv-radiosensitive (B-15) and uv-radioresistant (B-17) strain of Escherichia coli B. Submerged electrical discharges in water, that have a potent microbicidal effect for a wide range of micro-organisms, consist of, among other features, ionization, heat, pressure shock wave, radiation, and chemical effects. The results obtained indicated that radiation from the arc might be essential for the microbicidal effect. The uv-radiosensitive strain was more susceptible to the discharges than an uv-radioresistant mutant derived from it. The kinetics of the inactivation by discharges were under certain conditions similar to those of continuous uv irradiation. Addition of uv-absorbing substances to the discharge liquid decreased the bactericidal efficiency of the discharges to an extent that paralleled the uv-absorbance. The bactericidal effect decreased as the distance from the spark increased. Bacteria enclosed in a cellophane bag were killed by discharges outside the bag, even when the bag was kept in the air above the discharge liquid. Bacteria inactivated by the discharges or by uv radiation were accessible to photoreactivation, but the magnitude of the reactivation was generally less than obtained with bacteria inactivated by continuous uv irradiation. (BBB)

50948 EFFECT OF HEAT, BUFFER SALT, AND H-ION CONCENTRATION, AND ULTRAVIOLET LIGHT ON THE INFECTIVITY OF HELIOTHIS AND TRICHOPLUSIA NUCLEAR-POLYHEDROSIS VIRUSES. Gudauskas, Robert T.; Canerday, Don (Auburn Univ., Ala.). J. Invertebr. Pathol., 12: 405-11 (Dec. 1968).

The thermal inactivation point of Heliothis nuclear-polyhedrosis virus (HPV) was between 75° and 80°C for 10 min; that of the Trichoplusia nuclear-polyhedrosis virus (TPV) was between 82° and 88°C. Infectivity of HPV was reduced at pH 2 or 12 for 30 min to 24 hr but was unaffected at pH 5, 7, or 9. TPV infectivity was not lost until a pH of 12 was reached. HPV was inactivated by uv light after 5 min at 2 in. from the light source (a Spectroline 2537 Å lamp). Infectivity of TPV was greatly reduced by exposures of 4 to 10 min to uv at 2 in.; total inactivation did not occur after 60 min, but did after 120 min. Effect of uv light on both viruses was progressively lessened as distance from light source to virus increased. The infectivity of TPV was reduced 60% by exposure of 4 to 6 min, and was reduced 92% after exposure of 8 to 10 min at 2 in. from the source. Infectious virus was still detectable after exposure for up to 60 min, but not after 120 min. Some average reductions in TPV infectivity following a 10-min exposure at various distances were as follows: 2 in., 97%; 4 in., 84%; 6 in., 80%; 20 in., 40%; and 32 in., 0%. (BBB)

50949 THE EFFECTS OF ULTRAVIOLET RADIATIONS ON THE CONTROL OF CELL METABOLISM AND SYNTHESIS IN ESCHERICHIA COLI B. Hamkalo, Barbara Ann. Amherst, Mass., Univ. of Massachusetts, 1968. 104p.

Thesis.

The effects of ultraviolet radiations (254 nm) on bacterial respiration, macromolecular syntheses, metabolism and growth were studied in order to investigate secondary changes which result from the presence of pyrimidine dimers in DNA. Cells of a radiation-sensitive strain, E. coli B_{s-1}, showed uncoupling of growth and respiration after a dose of 400 ergs/mm^2. Uncoupling is photoreactivable, which indicates a relationship of growth and respiration to the functioning of DNA. Macromolecular syntheses, as measured by the incorporation of radioactive precursors into cold acid-insoluble material, ceased within two hours after uv, similar to the growth data. Irradiated cultures of a radiation-resistant strain, E. coli B/r, show coordination of growth, macromolecular syntheses and respiration after uv. However, the specific physiological responses depend upon the carbon source which the cells oxidize before and after irradiation. Glycerol-, acetate- and succinate-grown cells exhibit a dose-dependent period of severe temporary inhibition of coordinated processes if cells are irradiated with doses from 300 to 600 ergs/mm^2. The photoreactivability of this inhibition and the lack of photoreactivability in a strain which lacks the PR enzyme, E. coli H/r, indicates that the presence of pyrimidine dimers in DNA causes this inhibition. Glucose- and pyruvate-grown cultures of B/r show less inhibition of growth and respiration after uv. Glycerol-grown cells fail to oxidize glucose or pyruvate after 60 min, therefore these carbon sources may be oxidized by a pathway uncommon to the oxidative pathway of glycerol, acetate, and succinate in cells adapted to glucose and pyruvate. The survival of cultures grown on any of the carbon sources tested was the same for a given dose, therefore the physiological responses noted do not appear to be related to the number of surviving cells after uv. Severe temporary respiratory inhibition does not appear to be due to a disturbance in ATP pool levels because although irradiated cells accumulate 2.5 to 5 times the amount of ATP as control cells by 30 min after uv, this accumulation is depleted to control values at the time of the onset of respiratory inhibition. Since respiratory inhibition sets in at the time DNA synthesis resumes in B/r, the physiological changes are interpreted as the functioning of a control mechanism that is particularly active in irradiated cells, and that acts to restore the ratios of DNA:RNA:protein, partly through the inhibition of the Krebs cycle. The physiological changes in B_{s-1} after uv indicate that this control is destroyed in these cells. There is little correlation between post-irradiation physiology and survival, however there appears to be a good correlation between uv-induced physiological changes and the ability of cells to repair uv-induced damage. (Disser. Abstr.)

50950 BACTERIAL EFFECT OF IONIZING IRRADIATION ON CERTAIN MICROORGANISMS. II. STUDY OF THE BACTERICIDAL EFFECT OF GAMMA RAYS ON CERTAIN BACTERIA AND THE SPORES OF BAC. ANTHRACIS. Genov, Ivan (Veterinary Inst. of Infectious and Parasitic Diseases, Sofia); F'odorov, Viktor; Fedorov, V.; Dimitrov, Dimitur; Antonov, N. Vet. Med. Nauki (Sofia), No. 7, 41-8(1968). (In Bulgarian).

Cultures of Pasteurella sp., Erysipelothrix insidiosa, Mycobacterium tuberculosis, and spores of Bacillus anthracis were exposed to γ radiation, following which the formation of L-transformed forms, protease activity, and survival time were determined. It was established that the resistance of the cultures depended on the rate of γ irradiation, and that it was not the same in the individual microorganisms. In the case of the strains of the pasteurellas, a bactericidal effect was observed at 300,000 R, in the case of Erysipelothrix insidiosa at 400,000 R, of Mycobacterium tuberculosis at 1,250,000 R and in the case of spores, at 1,500,000 R. L-transformed forms appeared at lower rates. The reversion of the individual cultures was followed up, the morphological changes of the L-transformed forms being studied under an ordinary and an electron microscope. The investigations showed that the protease activity of the cultures underwent almost no changes within the limits of the bacteriostatic rates of γ rays, but changes occurred at bactericidal rates. (JPRS)

50951 STUDIES ON REACTIVIATION IN POXVIRUS GROUP. I. REACTIVATION OF VACCINIA VIRUS. Mazur, Benedykt. Med. Dosw. Mikrobiol., 20: 309-14(1968). (In Polish).

Vaccinia virus inactivated by uv radiation could be reactivated in experiments in FL tissue cultures. The frequency of reactivation seemed to depend on the time of uv exposure, i.e., on the degree of injury to virus genetic material and on the number of inactive virus particles in aggregates. (auth)

50952 EFFECT OF γ-IRRADIATION ON METABOLIC ACTIVITIES OF FOOD MICROORGANISMS. 1. YEASTS AND LACTIC ACID BACTERIA. Sasaki, Yuji; Takao, Shoichi. (Hokkaido Univ., Sapporo). Hakko Kogaku Zasshi, 47: 97-101(Feb. 1969). (In Japanese).

As a fundamental experiment on the radiosensitivity of metabolic activities in food microorganisms, the effects of γ irradiation on alcoholic fermentation by yeast and on acid production by lactic acid bacteria were investigated. In the studies employing two strains each of Saccharomyces cerevisiae, Sacch. cerevisiae var. ellipsoideus, Sacch. sake and one strain of Candida albicans, the enzymatic systems in alcoholic fermentation by yeast seemed much more resistant to radiation than yeast cells, because the alcoholic fermentation occurred vigorously even after irradiation at a dose of 5×10^5 R or more, where scarcely any strain of yeast could form colonies on a plate culture. The lactic acid-forming enzymatic systems in Lactobacillus bulgaricus, Lact. plantarum, Streptococcus lactis and Leuconostoc mesenteroides were also more resistant to radiation than their cells. Skim milk was found to have a highly protective effect against radiation in alcoholic fermentation as well as on yeast cells. The radioprotective effect of skim milk was also observed on lactic acid bacteria. (auth)

50953 RAPID MIXING AND PULSE RADIOLYSIS EQUIPMENT AS TOOLS IN RADIOBIOLOGICAL RESEARCH. Brustad, T. (Norsk Hydro's Inst. for Cancer Research, Montebello, Norway). Scand. J. Clin. Lab. Invest., 22: Suppl. 106: 31-40(1968).

Instrumentation for studying rapid mixing and pulse radiolysis is described and some examples are given to illustrate the use of these techniques for elucidation of radiation-induced short-lived products and their possible role in radiobiological processes. The radiation source used in these studies was a 4-MeV linear accelerator. The accelerator can be operated on repetitive pulsing, continuously variable from 50 to 500 per sec, as well as on single pulsing. The pulse length can be varied continuously from more than 2 to 0.5 μsec. The maximum total energy in a 1.5-μsec electron pulse in the case of repetitive pulsing is about 2 J, corresponding to a dose of about 0.1 Mrad in water. Mechanisms of radiosensitization in chemical and biological systems obtained by pulsing techniques are reviewed. The rapid mixing apparatus was used to study the time course of action of the anoxic radiosensitizer, triacetoneamine-N-oxyl (TAN). A search is being made for more effective and less toxic anoxic sensitizers for use in radiotherapy. For Escherichia coli B/r, TAN is equally effective at a concentration $\frac{1}{10}$ that of some previously studied analogous compounds, and it does not sensitize aerobic cells. Some preliminary results are reported of the use of rapid mixing techniques in radiobiology. TAN in a concentration of 10^{-3} M was not toxic to E. coli B. With E. coli B, TAN (10^{-3} M) sensitized anoxic cells, whereas it did not sensitize aerobic cells. In the presence of 10^{-3} M TAN the oxygen enhancement ratio was only about 1.5, but about 2.6 in the absence of TAN. Experiments with rapid mixing equipment showed that TAN (10^{-3} M anoxic solution) when added 10 msec or longer after irradiation of anoxic bacteria had no sensitizing effect but showed considerable sensitization when anoxic bacteria and TAN were mixed 10 msec before irradiation. Qualitatively, this sensitization pattern appeared similar to that of oxygen. (BBB)

50954 PROTECTIVE EFFECTS OF SPECIFIC IMMUNITY TO VIRAL NEURAMINIDASE ON INFLUENZA VIRUS INFECTION OF MICE. Schulman, Jerome L.; Khakpour, Manijeh; Kilbourne, Edwin D. (Cornell Univ., New York). J. Virol., 2: 778-86(Aug. 1968).

Ultraviolet inactivation of influenza virus and its use in stimulating antibody production in mice is described. Allantoic fluid seed viruses were inactivated by uv irradiation prior to parenteral inoculation into mice. Fluids were centrifuged at 8000 rev/min, dialyzed at pH 7.2 overnight, and then subjected to uv light from a 7.5-w GE lamp (2537 Å) at a distance of 17.8 cm for 2 min. Antibody specific for viral neuraminidase could also be demonstrated in mice following pulmonary infection with influenza virus, immunization with isolated neuraminidase of influenza A_2 virus, and passive immunization with sera of rabbits immunized with isolated A_2 neuraminidase. Neuraminidase antibody produced by any of these methods or with uv-inactivated virus exerted a profound inhibiting effect on virus replication in the lungs of mice challenged with strains of virus having homologous neuraminidase protein, even in the absence of hemagglutinating-inhibiting antibody to the challenge virus, and results in markedly decreased pulmonary virus titers and diminished lung lesions. It is suggested that antineuraminidase immunity may play a significant role in the protection against influenza virus challenge observed in mice after infection or artificial immunization. (BBB)

50955 COLICINE I FACTORS DEFECTIVE FOR UV PROTECTION. Howarth-Thompson, S. (Univ. of Otago Medical School, Dunedin, N. Z.). Proc. Univ. Otago Med. Sch., 47: 16-17(Apr. 1969).

Colicin factor colIb-P9 when present in Salmonella typhimurium and Escherichia coli causes a change in uv response. Resistance to the lethal effect is increased and susceptibility to the mutagenic effect, as measured by the frequency of reversion to prototrophy, is also increased. Following treatment of a colicinogenic strain of S. typhimurium LT2, tryD-1(colIb-P9), with N-methyl-N-nitroso-N'-nitroguanidine (NG) a search was made for colicin factor mutants which no longer conferred uv protection. Of 375 survivors tested, 14 showed some degree of decreased uv survival. In two cell lines this was caused by mutation in the colicin factor, as demonstrated by the perpetuation of the new pattern of uv response in strains to which the factors were transmitted. They were from separate cultures of NG-survivors and, therefore, likely to be of independent origin. When newly introduced into strain tryD-1, both defective factors conferred little, if any, uv protective effects, and there was a corresponding decrease in the frequency of induced reversion to a level more typical of the noncolicinogenic strain. The simultaneous change in response to the lethal and mutagenic effects of uv indicate that the same function of colIb-P9 is responsible for both. (BBB)

50956 THE USE OF BETA-PROPIOLACTONE AND ULTRAVIOLET IRRADIATION FOR THE TREATMENT OF VIRAL CONTAMINATION OF CANINE SERUM. Yoshimura, Masao; Higashihara, Minoru; Masu, Shigeru (Kitasato Inst., Kashiwa, Japan). Kitasato Arch. Exp. Med., 40: 57-67(Dec. 1967).

The effect of uv irradiation and β-propiolactone (BPL) on bacteriophage T_4 artificially contaminating canine serum was examined. A 15-W germicidal lamp (peak emission at 2537 Å) was used to give uv radiation dose rates of 0.33, 0.66, and 2.0 W/cm^2 sec. When BPL and uv radiation were used singly, inactivation of the virus was complete with 0.2% BPL for 120 min or with 2.0 W/cm^2 sec of uv irradiation for 8 min. However, incomplete inactivation were observed with 0.1% BPL or with smaller doses of uv irradiation. When BPL and uv were used simultaneously, satisfactory inactivation of the virus was obtained within a short time. BPL showed very little effect upon the titer of anti-infectious hepatitis antibody in dog serum. No local and systemic reaction of consequence was noted in any of the dogs injected with canine serum treated with BPL. The amount of uv irradiation needed in simultaneous use was less than 1/3 that needed when given alone, but the concentration of BPL in simultaneous use was the same as that when used singly. (BBB)

50957 ANTIGENICITY OF PSITTACOSIS VACCINES KILLED BY IONIZING RADIATION. Wright, George G.; Swack, Norman S.; Mitzel, John R. (Medical Sciences Lab., Fort Detrick, Frederick, Md.). Proc. Soc. Exp. Biol. Med., 131: 858-60(July 1969).

Exposure of suspensions of the Borg strain of Chlamydia psittaci to graded doses of γ radiation resulted in loss of infectivity. Exposure in the frozen state produced slower loss of infectivity than exposure in the fluid state, doses of 400,000 and 250,000 R being required, respectively, for complete loss of detectable infectivity. Both reactions deviated moderately from first-order behavior. The frozen suspensions retained greater antigenicity for mice than did the fluid suspensions and were also more antigenic than suspensions killed by treatment with formaldehyde. (auth)

50958 ULTRAVIOLET LIGHT EFFECTS ON THE BACTERIAL CELL. Doudney, C. O. Curr. Topics Microbiol. Immunol., 46: 116-75(1968).

A review of 214 references considers the effects of uv damage to nucleic acid on the macromolecular synthetic activities of the bacterial cell in relation to normal control mechanisms and with the activities of the cell in restitution of the damage by uv to nucleic acid-synthesizing mechanisms. It examines uv-induced mutation and uv effects on recombination as events in the nuclear physiology of the uv-damaged bacterial cell. The available evidence supports the hypothesis that most uv-induced mutations arise as a result of the induction of pyrimidine dimers in DNA and can be prevented by photoreactivation involving photoenzymatic splitting of the dimer. In radiation-resistant bacteria this type of nondark repairable mutation is dependent on a mechanism which involves: excision of pyrimidine dimers resulting in gaps in the DNA single strands (accounting for the immediate loss in mutation photoreversibility); and repair-replication filling in the gaps which occurs before semiconservative DNA replication with a certain probability for error resulting in mutation. Subsequent semiconservative DNA replication results in expression of the mutant character. Such uv-induced mutation may result through an error introduced in the DNA by an inaccurate repair process (which presumably fills in the gaps left after dimer excision). (BBB)

50959 GAMMA-IRRADIATION RESISTANT MUTANTS OF ESCHERICHIA COLI: MODIFIED ENZYME SYNTHESIS REPRESSIBLE BY ARGININE AND URACIL. Robern, Haskel; Thatcher, F. S. (Food and Drug Directorate, Ottawa). Can. J. Microbiol., 15: 549-54(June 1969).

The levels of ammonia- or glutamine-dependent carbamyl phosphate synthetase (CPS), aspartate transcarbamylase (ATC), and ornithine transcarbamylase (OTC) were determined in wild-type Escherichia coli and in three mutants resistant to γ irradiation designated as 1γ, 6γ, and 12γ. Enzyme assays were conducted on the cultures after growth in an arginine–uracil-free medium (AUF) or in AUF medium supplemented with arginine and uracil (C). The growth rate of the wild type and 1γ was the same in AUF or C medium but the levels of CPS, ATC, and OTC in the 1γ mutant ranged from two to four times as high as in the wild-type strain when grown in AUF medium. The 6γ mutant grew more slowly than the wild type and 1γ strains but its rate of growth was the same in all media. When this mutant was grown in AUF medium, the levels of CPS and OTC were as high as in the 1γ mutant but the level of ATC was about the same as in the wild-type strain. The 12γ mutant was the slowest growing and required both arginine and uracil. When the culture was grown in limiting amounts of uracil and excess arginine or vice versa, the ammonia-dependent activity of CPS was higher than in the wild-type strain, but glutamine-dependent CPS, OTC, and ATC were not synthesized by this mutant. Cultures grown in medium C showed only residual activity of all enzymes tested. These results suggest that the 1γ, 6γ, and 12γ mutants have abnormally low pools of arginine and uracil; the mechanism for feedback inhibition is more sensitive to ionizing radiation than the catalytic mechanism; all damage caused by γ radiation is at the gene level; the locus controlling the synthesis of the ammonia-dependent activity of CPS is the least sensitive to γ radiation, and is subject to cumulative repression by uracil and arginine. (auth)

50960 THE EFFECTS OF RADIATION ON CHICAGO METROPOLITAN SANITARY DISTRICT MUNICIPAL AND INDUSTRIAL WASTEWATERS. Touhill, C. J.; Martin, E. C.; Fujihara, M. P.; Olesen, D. E.; Stein, J. E.; McDonnell, G. (Battelle Memorial Inst., Richland, Wash.). J. Water Pollut. Contr. Fed., 41: Research Suppl., R44-60(Feb. 1969).

The effects of radiation on industrial effluents containing cyanides, phenols, and petroleum-related wastes, and on bacteria and viruses commonly found in municipal wastewater streams were studied. Two ^{60}Co facilities were used for both static and dynamic studies. Results showed that both cyanide and phenol could be degraded readily to innocuous end-products, but degradation of petroleum-related wastes was limited. For the 0.5- to 45-mg/l cyanide concentrations normally encountered by the Metropolitan Sanitary District, degradation proceeded readily with essentially complete destruction in 60 min at a dose rate of 1.74×10^5 R/hr. The rate of degradation did not vary appreciably over the 26° to 75°C range studied indicating that the reactive species participating in the degradation of cyanide are formed in the radiation process. The reaction is a free radical process rather than an ionic reaction; also, oxygen concentration did not affect the rate of cyanide degradation. Radiation dose rate was critical to the degradation of cyanide. Higher dose rates resulted in higher rates of degradation. Irradiated cyanide solutions had no adverse effect on the biodegradation of domestic wastewater in an aerobic environment. At 1000-mg/l concentrations of phenol, addition of oxygen during irradiation did not affect significantly the rate of degradation, but for 10- and 100-mg/l phenol solutions the addition of air or oxygen, either by direct injection into the irradiation coil or by sparging of the original solution, greatly accelerated the rate of degradation during irradiation. For dodecane and normal

paraffin hydrocarbons, used to simulate constituents of petroleum-related wastes, degradation was limited. Organism kill curves were developed for total counts, coliforms, Escherichia coli phage plaques, enterococci, and spores as a function of radiation dose rate and total exposure. At a total dose of 2.5×10^5 rad, the following microorganism kills were obtained: total counts, 99.995%; coliforms about 100%; enterococci, about 100%; spores, 92%; and E. coli phages, about 100%. (BBB)

50961 SKIN, LIVER, AND CORNEAL LESIONS PRODUCED BY INJECTIONS OF HIGH INFECTIOUS TITER AND UV-IRRADIATED PREPARATIONS OF HERPES SIMPLEX VIRUS IN RABBITS AND GUINEA PIGS. Tokumaru, Tadasu (Univ. of Pennsylvania, Philadelphia). Proc. Soc. Exp. Biol. Med., 131: 1099-1106(Sept. 1969).

Tissue lesions consisting of erythema and induration of the skin, hemorrhagic necrosis of the liver, and corneal opacity were produced by uv-irradiated herpes simplex virus. These toxic effects were completely neutralized by herpes antiserum. Other biologic effects of the herpes virus, namely, fatal tonic convulsions and the formation of multinucleate giant cells in the liver, were destroyed by the uv irradiation of the virus. (auth)

Radiosterilization and Radiopreservation

Refer also to abstracts 50041, 50051, 50194, and 50399.

50962 (MIT-4049-1) TOXIN PRODUCTION BY NATURALLY OCCURRING LEVELS OF CLOSTRIDIUM BOTULINUM IN IRRADIATED AND NONIRRADIATED SEAFOOD. Progress Report, 1969. Nickerson, J. T. R.; Goldblith, S. A. (Massachusetts Inst. of Tech., Cambridge). Aug. 15, 1969. Contract AT(30-1)-4049. 16p. Dep. CFSTI.

A total of 40 samples (120 individual portions) of commercially produced fish fillets has been incubated and tested for botulism toxin. Each sample has consisted of ground and mixed cod or haddock fillets packaged in polyethylene as three, 100 gram, portions. One portion of each sample received no further treatment, one portion was irradiated with gamma rays at a dose level of 100 krad, and one portion was irradiated with gamma rays at a dose level of 200 krad. All portions of all samples were incubated for 6 days at 70°F then extracted with gel-phosphate buffer. The trypsinized and nontrypsinized extracts were injected intraperitoneally into mice, protected and not protected with botulism antitoxins (types A, B, and E). All mice had been treated with antibiotics prior to injection. The mice were observed over a period of 96 hours for symptoms of botulism. Among the 120 individual portions tested none have been found to contain botulinum toxin. Whereas controls (unirradiated) have caused death more frequently than irradiated portions, the symptoms are atypical of botulism. So far as these experiments have gone, therefore, they have indicated that low dose level irradiation treatment of cod and haddock fillets has not influenced the outgrowth of Clostridium botulinum. The dose rate of Mark II cobalt 60 source has been determined. This has been done in such a manner that the same mass was present in the irradiation chamber as when fish fillets were irradiated in portions of 20 pounds (two 10 pound containers) and as the 100 gram portions are being irradiated for experiments now being conducted. (auth)

50963 (NYO-2043-195, pp 75-108) STERILIZATION OF THE MEDITERRANEAN FRUIT FLY AND ITS APPLICATION TO FLY ERADICATION. Katiyar, K. P.; Ramirez, E. (Inter-American Inst. of Agricultural Sciences, Turrialba (Costa Rica)).

The feasibility of the release of γ-radiosterilized male Mediterranean fruit flies for fly eradication was investigated. From September 1968 to April 1969 approximately 40 million irradiated flies were released each week in a test area of 48 square kilometers in Carazo, Nicaragua. A survey indicated approximately 90% reduction in fly infestation in the release area. Results are reported from a search for cheaper diets for use in raising the flies, a study of the mating habits of males and females, a study of the mutagenic effects of EMS in fruit flies, and a study of the resistance of flies in the field to the insecticides, Dieldrin, Lebaycid, and Malathion. (C.H.)

50964 (ORO-3097-8) EFFECTS OF LOW LEVEL IRRADIATION UPON THE PRESERVATION OF FOOD PRODUCTS. Annual Report, April 15, 1966-April 14, 1967. Dennison, R. A.; Ahmed, E. M.; Merkley, M. S. (Florida Univ., Gainesville. Dept. of Food Science). Apr. 1967. Contract AT(40-1)-3097. 110p. Dep. CFSTI.

The severity of the irradiation-induced peel injury in citrus fruits may be reduced by storage at low temperature, short-term storage and hot-water dip treatment prior to irradiation. No differences in the contents of reducing sugars, sucrose and total sugars in citrus fruits were observed due to irradiation. The hot-water dip treatment did not cause any changes in the amounts of sugars present. Slight losses in reduced ascorbic acid contents, in the order of 5 to 15%, were found during storage of irradiated citrus fruits. Higher juice yields were obtained from irradiated Duncan grapefruit. However, similar juice yields were obtained from irradiated and non-irradiated Valencia oranges. The juices expressed from irradiated Duncan grapefruit and Valencia oranges exhibited higher visocities than those obtained from non-irradiated fruit. No differences in soluble solids, titratable acidities, weight losses, and pH were observed due to shipping. Shipping resulted in about 10% losses of ascorbic acid in addition to that caused by irradiation. The reductions in the severity of peel injury ratings of the irradiated fruit during the early part of the storage period were offset by the stress suffered by the fruit during shipping. (auth)

50965 (PHS-999-RH-33, pp 169-72) CHANGES INDUCED BY THE IRRADIATION OF NUTRITIONAL ELEMENTS. Ghys, Roger (Montreal Univ. (Quebec). Inst. of Microbiology).

Postirradiation changes that affect the wholesomeness and acceptability of foodstuffs are briefly reviewed. Topics included inhibition of seed germination, viral versus enzyme inactivation, production of free radicals, radioactivation of processed foods, nutritional changes in irradiated foods, organoleptic properties, and changes induced following the consumption of irradiated foods. (C.O.)

50966 (RLO-1950-3) EFFECT OF IRRADIATION ON THE MICROBIAL FLORA SURVIVING IRRADIATION PASTEURIZATION OF SEAFOODS. Final Report. Sinnhuber, R. O.; Lee, J. S. (Oregon State Univ., Corvallis. Dept. of Food Science and Tech.). Sept. 4, 1968. Contract AT(04-3)-502. 64p. Dep. CFSTI.

In Part I, the sublethal effects of radiation on microorganisms, such as induced susceptibility to salt, chemical preservatives, and antibiotics are tested. The experimental results, with microorganisms that would survive radiation pasteurization, indicated that the above agents would similarly affect both irradiated and non-irradiated cells. The spoilage characteristics of microorganisms in seafoods are examined in Part II. The microorganisms representing irradiated and non-irradiated flora were inoculated into sterile fish muscle, and the productions of total volatile acids and bases in these samples were followed during 1°C storage. The experimental results revealed that the active microbial species could be found in both irradiated and non-irradiated seafoods. The third part contains a summary of accomplishments since the initiation of the contract. The data supporting the conclusions are provided in the accompanying appendix. Detailed discussion of each topic, however, can be found in publications listed in the summary. (auth)

50967 FOOD IRRADIATION AS A THREAT TO DEEP-FREEZING PROCESSES. Masefield, J. (Masefield Irradiation Consultants Ltd., Montreal). Isotop. Radiat. Technol., 7: 77-9(Fall 1969).

The status of food irradiation as a process commercially competitive with deep freezing is examined. The use of radiation to depress growth, destroy insects, pasteurize, and sterilize is explained. The problems of obtaining approval from health authorities and of controlling organoleptic changes are pointed out. Food irradiation does not at this time present a threat to deep freezing. (auth)

50968 STATUS AND FUTURE POSSIBILITIES OF FOOD IRRADIATION. Diehl, J. F. (Bundesforschungsanstalt fuer Lebensmittelfrischaltung, Karlsruhe, Ger.). pp 1-15 of Nahrungsmittelbestrahlung. Zurich, Forster-Verlag AG, 1967. (In German).

The technical and legal aspects of sterilization and pasteurization of foodstuff by radiation is briefly reviewed. Thus far, none of the countries of continental Europe has authorized use of irradiated food. However, a rapidly increasing application of the method is predicted for the near future. This prediction is based on the following facts: superiority of the radiation method for elimination of Salmonella infection in heat sensitive materials; preference of radiation because of increasing apprehension about using organic chemicals to prevent germination of potatoes and onions, to delay ripening of oranges and bananas, and to eliminate insects from grains. Radiation treatment is also necessary to prevent the spread of microorganisms and insects in increasing world trade. (H.B.G.)

50969 INDUSTRIAL TESTING OF GAMMA-EXPOSURE OF POTATOES FOR THE PREVENTION OF SPROUTING. Metlit-

skii, L. V. (Inst. of Biochemistry, Moscow); Korableva, N. P.; Shalinova, R. T. Konserv. Ovoshchesush. Prom., No. 1, 23-5 (1968). (In Russian).

Exposure of potatoes to a dose of 7 to 10 Krad γ radiation leads to a loss of the capacity of the cells to divide normally and grow and is accompanied by a complete loss of the capacity to germinate. This exposure, however, also disrupts the process of energy accumulation and prevents formation of protecting substances, thereby increasing the danger of disease by microorganisms. The potatoes were irradiated at different times: immediately after harvesting, after two weeks, three and seven months, using integral doses of 5, 7, and 10 Krad with an output of 1.75, 20, and 800 R/sec. These doses were given either in one portion or fractionally. After four months storage the loss of weight of the unexposed potatoes was somewhat higher than that of the exposed. By July the unexposed potatoes had sprouted tremendously, whereas tubers exposed to a dose of 10 Krad did not grow at all, and those with a dosage of 7 Krad grew insignificantly. Therefore a dosage of 7 Krad was considered sufficient for short term storage. With an integral dosage of 7 Krad an increase in the capacity of the dose from 1.75 R/sec to 20 R/sec greatly increases the inhibiting effect on sprouting, but it also increases loss as a result of microbial spoilage. This loss is lessened if exposure of the potato begins two weeks after harvesting, i.e., after healing of mechanical damage during harvesting. Exposure may take place at any time up until March when natural sprouting begins. Doses up to 10 Krad do not affect the percentage of sugar or starch in the potato. Exposure two weeks after harvesting or later does not appreciably affect the amount of ascorbic acid in the potato. Vitamins of the B group are not affected by radiation up to 10 Krad, although higher dosages led to a sharp increase in loss of vitamin B. Exposure had no effect on the content of nitrogenous substances except during the first storage period when some of the non-protein nitrogen increased (from 4.2 mg to 5.6 mg) at the expense of the decomposition of protein nitrogen (from 8.4 to 7 mg). With prolonged storage the quantity of protein and non-protein nitrogen in exposed and unexposed potatoes was equal. Exposure did not affect analysis or taste of products made from potatoes after ten months storage. The experiments show that γ exposure of potatoes is an effective method of preventing sprouting during storage and permits storage without artificial cooling. The cost is commensurate with the cost of chemical treatment now in use. (JPRS)

50970 COLOR REGENERATION OF FROZEN TUNA MEAT BY GAMMA IRRADIATION. Yamanaka, Hideaki; Amano, Keishi (Tokai Regional Fisheries Research Lab., Tokyo). Nippon Suisan Gakkaishi, 35: 101-8(Jan. 1969). (In Japanese).

Discoloration of frozen tuna meat has been unavoidable, causing its unprofitable market price. A known action of γ irradiation to convert metamyoglobin into oxymyoglobin was examined as to the color improvement of frozen tuna. The conversion from metamyoglobin to oxymyoglobin occurred in proportion to the level of given γ dosage. A dose of 0.2 Mrad was found adequate to develop a satisfactory color regeneration without leaving off-flavor of the product. However, the regenerated meat color was only transitory because of the reversible formation of metamyoglobin even under freezing condition at −20°C. And it was found that storage condition that enables a sufficient supply of oxygen into the irradiated tuna meat is effective to retain the red coloration. Packaging of the irradiated meat with a permeable film such as polyethylene after slicing into thinner fillet may be one of the feasible ways. The changes in the components of water-soluble protein of tuna meat by irradiation was not detected at the level lower than 1.0 Mrad by starch-gel electrophoresis. (NSA of Japan)

50971 CHEMICAL SENSITIZATION OF BACTERIAL SPORES TO RADIATION IN FOOD. Corlett, Donald A. Jr.; Anderson, Arthur W.; Elliker, Paul R.; Krabbenhoft, Kenneth L. (to Battelle Development Corp.). U. S. Patent 3,401,044. Sept. 10, 1968. Filed Aug. 26, 1965.

Meat is sterilized and preserved using high energy ionizing radiation by introducing sodium chloride in combination with sodium nitrite or sodium nitrate into the meat prior to irradiation to render bacteria therein sensitive to a dose of ionizing radiation sufficient to sterilize the meat without destroying its natural characteristics. (auth)

50972 PROCESS FOR PRESERVING FISH BY IRRADIATION. Huff, John B. (to Secretary of the Interior). U. S. Patent 3,434,850. Mar. 25, 1969. Filed July 29, 1966.

This invention relates to an apparatus and method for irradiating solids, fluids, or solids suspended in fluids by passing the material in a helical path around a cylindrical source. The system finds particular utility in the irradiation pasteurization of bulk foods. An example of the invention is illustrated by the passage of a gel-like semisolid mixture of filleted fish suspended in agar through a helical path around a cylindrical source. The use of multistage and multipass irradiators is suggested to assure uniform dosages of such semisolid materials. (auth)

50973 THE PRODUCTION OF PARTIALLY STERILE MUTANTS IN GLOSSINA AUSTENI. Curtis, C. F. (Univ. of Bristol, Eng.). Genet. Res., 13: 289-301(June 1969).

Ionizing radiation was used in attempts to induce a chromosome translocation that might be used to manipulate the frequency of a desirable gene in a pest population, namely tsetse flies (Glossina spp.), the vectors of African trypanosomiasis and therefore of great medical and veterinary importance. The progeny of irradiated individuals were tested for the occurrence of inherited partial sterility. Doses of ^{60}Co γ radiation were given to males on their ninth day of adult life. The dose rate was about 100 rad/min and during irradiation the flies were under conditions of unrestricted aeration. Each irradiated male was then mated to a single untreated virgin female, so that the spermatozoa transferred to the female were mature at irradiation. Radiation doses of 5, 6, or 7 kR given to 100 males induced dominant lethals in 70 to 90% of their sperm, but the remaining zygotes produced F_1 progeny which showed normal survival to maturity. Thirty-four percent of the testable sons of males which received doses of 5 to 7 Krad showed inherited partial sterility. In two cases the inheritance was patrilineal which suggests that the Y chromosome was involved. In most others, a segregation among both male and female progeny of the partially sterile and normal types occurred and only autosomes seemed to be involved. Among males in these stocks the segregation ratio was close to 1:1, but in females there was a deficit of the partially sterile type, associated with the large proportion of totally sterile and inviable females produced by these stocks. The proportion of zygotes, which died at the embryonic, larval, and pupal stages from partial sterility factors, varied between factors of different mutational origin. The pattern of inheritance of these factors and their high frequency of induction indicate they are translocations in the heterozygous state. (BBB)

50974 EFFECTS OF ^{60}Co GAMMA RAYS ON CHANGES IN ORGANOLEPTIC PROPERTIES, FLESH FIRMNESS, SURFACE COLOR AND RESPIRATION OF APPLE FRUITS. Okamoto, Tatuo; Harata, Junko (Hirosaki Univ., Aomori, Japan). Hirosaki Daigaku Nogakubu Gokujutsu Hokoku, No. 15, 38-45(Mar. 1969).

Jonathan apples were irradiated by ^{60}Co gamma rays, with doses of 0 (control), 5, 50, 100, 200, 300 Krad (dose rate: 100 Krad/hr), and 300, 400, 500, 750, 1000, 1500 Krad (dose rate: 1000 Krad/hr), and stored in a refrigerated room at 0°C. The evaluation on their organoleptic properties, flesh firmness, surface color and respiration is as follows. No significant effects on organoleptic properties, flesh firmness and surface color were recognized below 50 Krad of irradiation with gamma rays after 1.5 months in cold storage. And even after cold storage of 3.0 months or more, no significant effects on them were recognized if the dose was less than 5 Krad. Furthermore, respiration rate of Jonathan apples subjected to 5 to 50 Krad of gamma rays showed a slight decrease in oxygen consumption compared with that of unirradiated apples. So, from the experimental results of 6.0 months, low doses of gamma irradiation such as 5 Krad may be recommended for cold storage of apple fruits. (NSA of Japan)

50975 BIOCHEMICAL STUDIES ON THE STORAGE OF IRRADIATED FRUITS AND VEGETABLES. Ogata, Kuniyasu; Chachin, Kazuo (Osaka Prefectural Univ., Sakai, Japan). Nippon Shokuhin Kogyo Gakkaishi, 16: 167-77(Apr. 1969). (In Japanese).

Foods were irradiated for inhibition of germination, sterilization, and destruction of parasites, insects, molds, and nits. Respiration was investigated by determining the amount of CO_2 eliminated; although results varied with the kinds of fruits and vegetables irradiated and the degree of ripeness, a temporary increase in respiration was commonly observed. Effects of radiation dose on respiration in pears, bananas, tomatoes, oranges, and persimmons during storage were observed. Effects of radiation on formation of ethylene, metabolism of plant hormones, nucleic acids, ascorbic acid, amino acids, and volatile components were also studied. (NSA of Japan)

50976 STUDIES ON MICROBIOLOGICAL SAFETY OF IRRADIATED FOODS. PART 1. ON THE NATURAL LEVEL OF CONTAMINATION OF IRRADIATED AND NON-IRRADIATED FISH FLESH WITH CLOSTRIDIUM BOTULINUM TYPE E. Ando, Yoshiaki; Kameyama, Kunio (Hokkaido Inst. of Public Health, Sapporo). Hokkaidoritsu Eisei Kenkyushoho, No. 19, 248-52 (June 1969). (In Japanese).

The results are summarized as follows: Tubes of flat fish homogenate (2:1) inoculated with 0, 1, 10^2, 10^3, and 10^4 spores of Clostridium botulinum type E, Iwanai were irradiated at 0, 0.1, and

0.3 Mrads. Toxin assay of each sample was carried out after storage at 10°C for two weeks and at 20°C for three days. Production of toxin was demonstrated in all of the samples inoculated with more than 10^2 spores, but was not in some of the samples inoculated with 10 and 1 spores. Total 200 fish including four species (flat fish, Hata-hata, Alaska pollack, and herring) were collected from the coastal districts in Hokkaido. Tubes of homogenates made from each of these fish were subjected to gamma irradiation at dosages of 0, 0.1, and 0.3 Mrads and subsequently stored at 10°C for two weeks and at 20°C for three days. Average 2 to 4.5% of the total samples irradiated at either 0 or 0.1 Mrads were found to contain type E toxin and the highest percentage found in Hata-hata was 8%. No toxin was detected in any of the samples irradiated at 0.3 Mrad. (NSA of Japan)

METALS, CERAMICS, AND OTHER MATERIALS

Metals and Alloys

Refer also to abstracts 50021–50024, 52305, and 52451.

50977 (BNWL-932) IRRADIATION EFFECTS ON REACTOR STRUCTURAL MATERIALS. Quarterly Progress Report, August–October 1968. Claudson, T. T. (ed.) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Dec. 1968. Contract AT(45-1)-1830. 234p. Dep. CFSTI.

ALUMINUM — radioinduced voids in high-purity, fast neutron
ARMY REACTORS (PM-2) — pressure vessel of 2A, preservice nil-ductility transition temperature of
BIG ROCK POINT POWER REACTOR — steel irradiation experiments in
CARBON — effects on mechanical properties of irradiated Incoloy 800
CHROMIUM ALLOYS AND SYSTEMS — Cr-Ti-V-base, radiation effects on tube-burst properties of, at 550°C, neutron
— Cr-Fe-Ni, radiation effects on tensile properties of superplastic, fast neutron
COPPER — radioinduced voids in high-purity, fast neutron
CRACKS — tip orientation factor calculations for hcp crystals
CREEP — testing of materials in sodium and gases, facility development for
HASTELLOY N — aging behavior of titanium-modified
— microstructures of standard and titanium-modified
— radiation effects on creep-rupture properties of titanium-modified, neutron
HASTELLOY X — radiation effects on creep-rupture properties of, at 540°C, fast neutron
HAYNES STELLITE NO. 25 — radioinduced embrittlement at high temperatures, fast neutron
HYDROGEN — effects on tensile properties of irradiated steels
— sorption by Zircaloy-2 in ammoniated water in G-7 loop
INCOLOY 800 — radiation effects on mechanical properties of, neutron
INFORMATION CENTERS — data storage for LMFBR fuel cladding
IRON — radiation effects on pure, mechanism studies of fast neutron
IRON ALLOYS AND SYSTEMS — Cr-Fe-Ni, radiation effects on tensile properties of superplastic, fast neutron
MOLYBDENUM — radiation effects creep-rupture properties of, at 1000°C, effects of carbon and irradiation temperature on
— radiation effects in, annealing of neutron
— radioinduced hardening of single crystals of pure, flux dependence and annealing of fast neutron
— radioinduced defect structure in carbon-doped single crystals of, neutron
MOLYBDENUM ALLOYS AND SYSTEMS — Mo-base-Ti, radioinduced hardening of
NEUTRONS — effects on mechanical properties of vanadium alloys
— effects on Type 304 stainless steel, model for void formation in
— effects on mechanical properties of Types 316 and 316L stainless steels with and without titanium
— effects on creep-rupture properties of titanium-modified Hastelloy N
— effects on monoclinic-tetragonal phase transition of uranium-doped zirconium dioxide in combination with pressure
NEUTRONS, FAST — effects on high-temperature tensile properties of alloys of varying nickel content
— effects on superplastic chromium-iron-nickel alloys
— effects on low carbon, low nitrogen stainless steel
— effects on niobium, Stage III recovery from
— effects on tensile properties of hydrogen-charged steels
— effects on structural steels
— effects on heat-resistant alloys and refractory metals
— effects on iron
— effects on stainless steels in EBR-II
— effects on microstructures of metals
NICKEL — production and structure of sputtered foils of fine-grained
— radioinduced voids in high-purity, fast neutron
NICKEL 200 — radioinduced embrittlement at high temperatures, fast neutron
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NIOBIUM — recovery in neutron-irradiated, mechanism of Stage III
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ZIRCONIUM OXIDES—radioinduced phase transition of uranium-doped, effects of pressure on neutron (R.C.K.)

50978 (BNWL-971) REACTOR FUELS AND MATERIALS DEVELOPMENT PROGRAMS FOR FUELS AND MATERIALS BRANCH OF USAEC DIVISION OF REACTOR DEVELOPMENT AND TECHNOLOGY. Quarterly Progress Report, October-December 1968. Bement, A. L.; Dau, G. J.; Evans, E. A.; Nightingale, R. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Feb. 1969. Contract AT(45-1)-1830. 272p. Dep. CFSTI.

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CARBON DIOXIDES—reactions with graphite, electron microscopic studies on
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—corrosion testing in ETR G-7 loop, effects of prefilming on in-flux
ZIRCONIUM ALLOYS AND SYSTEMS—Nb-Zr-base, creep testing of, in-pile
—Nb-Zr-base, fracture-crack testing of heat-treated hydrided tubing of (D.L.C.)

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Refer also to abstracts 50069, 51022, 51107, and 51108.

50979 (AEC-tr-6978) CORROSION OF ZIRCONIUM AND ZIRCONIUM ALLOYS. Parfenov, B. G.; Gerasimov, V. V.; Venediktova, G. I. Translation of Korroziya Tsirkoniya i Ego Splavov, Moscow, Atomizdat, 1967. 188p. (TT-69-55014; IPST-Cat.-5403). Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 21: 39555.

50980 (AECL-3365) CURRENT KNOWLEDGE OF ZIRCONIUM ALLOYS FOR REACTOR USAGE. Boulton, J. (Atomic Energy of Canada Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment). June 1969. 18p. (CONF-690615-5). Dep. CFSTI (U. S. Sales Only). CAN $0.50.

From 9th Annual Nuclear Association Conference, Montreal, Canada.

The corrosion behavior, mechanical properties, and creep of zirconium alloys are discussed in relation to their use as fuel cladding or pressure tubing in pressurized or boiling water reactors operating at about 300°C. Particular emphasis is placed on the effects of irradiation and hydrogen which is absorbed during service. Most attention is paid to Zircaloy-2 and Zr-2½% Nb but other alloys such as Ozhennite 0.5, Zr-1% Nb, and Zr-3% Nb-1% Sn are briefly mentioned. It is suggested that, although Zircaloy-2 has performed well in actual service, the Zr-2½% Nb alloy offers considerable advantage in terms of higher strength, better in-reactor creep performance, and superior corrosion resistance particularly under boiling water reactor conditions. The use of zirconium alloys at higher temperatures is considered. Ozhennite 0.5 shows high corrosion and hydriding resistance in organic coolants and is a potential fuel cladding and pressure tube material for an organic cooled reactor operating at outlet temperatures of 400 to 425°C. An alloy with better corrosion and hydriding resistance to steam at temperatures of 400 to 500°C than either Zircaloy-2 or Zr-2½% Nb would offer advantages for use as fuel claddings in high steam quality boiling water reactors or possibly even in superheat. Ozhennite 0.5 and Zr-1% Cr-0.1% Fe are presently being considered for this application. (auth)

50981 (IN-1307) COMPATIBILITY STUDY OF COMMON THERMOCOUPLE MATERIALS WITH FHUST ZIRCALOY-CLAD HEATERS. McGrath, T. J.; Williams, D. E. (Idaho Nuclear Corp., Idaho Falls). Sept. 1969. Contract AT(10-1)-1230. 18p. Dep. CFSTI.

A series of scoping studies, to aid in the development of techniques for bonding thermocouples to the Zircaloy-clad heaters used in the FHUST program, was performed to determine the compatibility and life of common thermocouple materials with Zircaloy. The bonding techniques were required to meet the following criteria: (a) preclude eutectic formation between the metals used in the thermocouple construction and the Zircaloy heater cladding, (b) withstand the oxidation produced by a steam atmosphere, (c) not deteriorate in environments of vacuum or inert gas, and (d) have a minimum life of ten tests at a temperature of 2200°F for several minutes duration. (auth)

50982 (JPRS-48330, pp 426-61) PROBLEMS OF CORROSION RESISTANCE OF STRUCTURAL MATERIALS IN SODIUM. Bykov,

V. N.; Zotov, V. V.; Kraev, N. D.; Nevzorov, B. A.; Umnyashkin, E. V.; Filippov, I. T. Translated from pp 451-81 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 1, Obninsk, 1967.

Methods of investigating corrosion of reactor structural materials by liquid sodium are described. Discussions are included on static and dynamic methods, corrosion and mass transfer parameters of austenitic steels, and effects of carbon transfer on structural material properties. Evaluations of the effects of temperature, liquid metal flow rates, oxygen content, and stresses on sodium circulating systems are also included. (J.R.D.)

50983 (JPRS-48330, pp 462-77) EFFECT OF OXYGEN CONTENT IN SODIUM ON THE CORROSION AND MASS TRANSFER OF THE FERRITE AND SOME STAINLESS STEELS. Ilinchev, G. Translated from pp 482-97 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 1, Obninsk, 1967.

Results of investigations concerning the relations between structural steel compositions and the corrosive effects of high temperature sodium containing oxygen are presented. (J.R.D.)

50984 (JPRS-48330, pp 478-85) MECHANISMS OF THE EFFECTS OF A LIQUID METAL MEDIUM ON SOLID METALS IN STRESSED STATE. Nikitin, V. I. Translated from pp 498-505 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 1, Obninsk, 1967.

An analysis of the effects of liquid metals on stressed solid metals is presented. Emphasis is placed on the effects of liquid metal adsorption, corrosion, and diffusion on mechanical properties of solid alloys and metals. A model is developed to represent the atomic interactions between liquid and solid metals in deformation cracks. (J.R.D.)

50985 (JPRS-48330, pp 486-517) CONTAMINATION OF SODIUM HEAT CARRIER. PROBLEMS OF IMPURITY MONITORING. Subbotin, V. I.; Kozlov, F. A.; Kuznetsov, E. K.; Sergeev, G. P.; Ivanovskii, N. N.; Kozub, P. S.; Dmitrieva, I. B.; Nalimov, Yu. P. Translated from pp 506-33 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 1, Obninsk, 1967.

Factors affecting sodium coolant contamination are summarized and the effects of each contaminant is discussed. Methods of monitoring impurity oxygen, hydrogen, hydrides, carbon, and nitrogen, are reviewed. (J.R.D.)

50986 (JPRS-48331, pp 512-52) STUDY OF STAINLESS STEELS APPLICABLE TO CORE CONDITIONS IN FAST REACTORS DEVELOPED IN THE USSR. Agapova, N. P.; Bogolepov, M. G.; Butra, F. P.; (and others). Translated from pp 457-91 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 2, Obninsk, 1967.

Evaluation of stainless steel for use as fuel cladding and for use in high temperature reactor cooling systems was conducted considering corrosion resistance in sodium, mechanical properties, behavior under neutron irradiation, and engineering properties. Information is included on effects of nickel and boron content on embrittlement under reactor conditions, and on effects of radio-induced phase separation. Information is also included on relations of grain structure and alloying additions with embrittlement. (J.R.D.)

50987 (K-1777) ELECTROLESS NICKEL PLATING FOR CORROSION PROTECTION OF URANIUM. Petit, G. S.; Wright, R. R.; Kienberger, C. A.; Weber, C. W. (Oak Ridge Gaseous Diffusion Plant, Tenn.). Oct. 13, 1969. Contract W-7405-eng-26. 29p. Dep. CFSTI.

Two electroless nickel plating methods have been developed for corrosion protection of metallic uranium. In one method, the uranium is heat-treated in a vacuum furnace and given an electrostrike in a nickel sulfamate bath to initiate the electroless plating process prior to placing it in the standard high-temperature electroless plating bath. In the second method, the plating is done in a low-temperature electroless bath, initiated by making the uranium cathodic for a few seconds. The nickel-plated uranium from either bath is heat-treated in a vacuum furnace to form a uranium-nickel alloy at the interface. Metallic uranium pieces varying in area from 7 in.^{2} to 17 ft^2 have been plated with nickel in the standard high-temperature electroless plating bath. Nickel deposits ranging in thickness from 0.0005 to 0.002 in. were readily plated with the thickness controlled to within ±0.0002 in. There was no porosity in the deposit and no peel-back of a freshly cut edge after 165 hr in a steam test bath. (auth)

50988 (K-1778) FORMATION OF CORROSION-RESISTANT OXIDE FILM ON URANIUM. Petit, G. S.; Wright, R. R.; Kienberger, C. A.; Weber, C. W. (Oak Ridge Gaseous Diffusion Plant, Tenn.). Oct. 13, 1969. Contract W-7405-eng-26. 26p. Dep. CFSTI.

A vacuum heat-treatment method has been developed for coating uranium metal with a protective uranium oxide film. No corrosion was observed on coated uranium coupons after they were exposed for several hundred hours in a corrosion test bath at 95°C and 100% relative humidity. The metallic uranium was coated by vacuum heat treatment at 625°C, using a controlled amount of oxygen. Varying the amount of oxygen added to the furnace provided control of film thicknesses in the range from 0.0002 to 0.001 in. The hard, blue film was nonwetting and very adherent; it had a surface finish equivalent to that on the original uranium metal. (auth)

50989 (ORNL-TM-2642) DEVELOPMENT OF ELECTROLESS NICKEL COATING FOR HIGH PERFORMANCE ALUMINUM FUEL PLATES. Cheverton, R. D.; Griess, J. C.; McGuffey, J. R. (Oak Ridge National Lab., Tenn.). Aug. 13, 1969. 23p. Dep. CFSTI.

There is a limit to the applicability of aluminum as a fuel cladding and matrix material in high performance water cooled research reactors. This limit is associated with corrosion, oxide thermal insulation, radiation damage, and loss of strength at high temperatures. One approach to extending the usefulness of aluminum is to deposit a corrosion resistant, electroless nickel coating on the surface of the fuel plates. An investigation using specimens coated with nickel by a new technique revealed that as-plated samples successfully withstood bend, thermal shock, and autoclave and dynamic corrosion tests without cracking, measurable corrosion, or sloughing. In one additional dynamic corrosion test a tubular specimen was electrically heated so as to provide a high heat flux through the nickel coating; small cracks developed, but there was no sloughing of the nickel. Following these tests on ORR fuel element was partially coated with nickel so as to introduce the effects of radiation. After ten weeks of normal operation, the nickel coating appeared to be in excellent condition. The tests were conducted in deionized water. A few out-of-pile tests were also conducted in pH 5 (HNO_3) water, and the results indicated an excessively high corrosion rate of the nickel. (auth)

50990 INFLUENCE OF GRAIN SIZE AND OXYGEN CONTENT ON THE OXIDATION KINETICS OF ZIRCONIUM. Com-Nougue, J.; Ono, K.; De Gelas, B.; Beranger, G.; Lacombe, P. (Ecole des Mines, Paris). J. Less-Common Metals, 19: 259-72(Nov. 1969). (In French).

The influence of two important factors, i.e., the grain size and the oxygen content of α-Zr, on the oxidation kinetics was studied and the results are discussed. Large α-Zr grain size samples (mean grain size 5 mm) have been obtained by thermally cycling in vacuum through the $\alpha \rightleftharpoons \beta$ phase transformation. At temperatures <650°C, the larger the grain size, the slower the rate of oxidation. This result can be explained by a grain-boundary diffusion mechanism at the lower temperatures. Zirconium–oxygen alloys have been prepared by oxidation of pure zirconium samples followed by a high-vacuum anneal at 1050°C. The homogeneity and final oxygen concentrations have been strictly verified and determined. The oxidation kinetics have been studied at different temperatures and it clearly appears that the oxidation rate markedly increases with increase of initial oxygen content. In addition, some structural observations in relation to the oxidation temperature have been made. (auth)

50991 OXIDATION OF URANIUM IN CARBON DIOXIDE AND CARBON MONOXIDE. A REVIEW. Pearce, R. J.; Whittle, I.; Hilton, D. A. (Central Electricity Generating Board, Berkeley, Eng.). J. Nucl. Mater., 33: 1-16(Oct. 1969).

A critical review of the data available on the oxidation of uranium in carbon dioxide and carbon monoxide is presented. The basic uranium–carbon dioxide reaction results in the production of uranium dioxide which, depending on the oxidation temperature, contains small quantities of free or combined carbon. Up to ~700°C the reaction is controlled by O^{2-} ion diffusion through a layer of oxide next to the metal. Above this temperature, however, the mechanism is uncertain due to the formation of a multilayer product and to difficulties in obtaining reliable isothermal data. Variations in the purity of the carbon dioxide or the metallurgical condition of the uranium affect the oxidation rate in the α-phase but become insignificant at higher temperatures. Data on the reaction of uranium with carbon monoxide are more limited. The principal products are uranium dioxide and uranium dicarbide and it is evident that the mechanism is complex and not well established. Similarly, the effects of irradiation during oxidation in carbon dioxide or carbon monoxide have not been fully investigated al-

though the data available suggest that the oxidation rates are not appreciably enhanced. (auth)

50992 NEW COBALT–NICKEL–MOLYBDENUM–CHROMIUM ULTRAHIGH-STRENGTH CORROSION-RESISTANT ALLOY SYSTEM: MULTIPHASE. Pugliese, L. A.; Stroup, J. P. Cobalt, No. 43, 80-6(June 1969).

Two alloys in the multiphase group, MP35N and MP20N (containing Ni 35 and 20%, respectively, with 20 Cr, 10 Mo, remainder Co) are reported, and many suitable applications for each are suggested. Stress-corrosion resistance to 700°C is claimed to be higher than that of Hastelloy B or C. (Metals Abstr.)

50993 REMOVAL OF HOT WORK AND HEAT TREAT SCALES FROM TITANIUM ALLOYS. Shoemaker, Robert H. (Kolene Corp., Detroit). Sci. Advan. Mater. Process Eng. Proc., 13: 193-204(1968).

From 13th National Symposium and Exhibit, Chicago, Ill. See CONF-680554.

Titanium shapes and fabrications can be completely cleaned and descaled, with good surface and retention of physical properties, if properly conditioned and pickled. Molten salts at 750 to 850°F have proved to be the most effective conditioning media for forged, extruded, and hot worked surfaces. Fabricated, heat treated, and hot formed surfaces are more efficiently conditioned in a 400°F low temperature molten salt. In either case, properly designed salt bath equipment should be used to minimize operational problems. Final cleaning is preferably accomplished in sulfuric acid followed by a brief nitric-hydrofluoric acid pickle. The use of molten salts to clean and descale titanium are well established in the aircraft and aerospace fields. (J.C.W.)

50994 CORROSION ENGINEERING. Fontana, Mars G.; Greene, Norbert D. Manchester, Mo., McGraw-Hill Book Co., 1967. 402p. $12.50.

Corrosion engineering covering the destruction or deterioration of engineering materials, both metallic and nonmetallic, by reaction between the material and its environment is discussed. Included are details on the cost of corrosion damage, forms of corrosion, corrosion testing equipment and methods, the properties of engineering materials, methods for preventing corrosion, the corrosive effects of acids and other environments, including high temperature, on materials, and the principles of modern corrosion theories and their application to predicting and preventing corrosion. (L.C.L.)

50995 MECHANISM OF THE ADHESION OF PLASMA COATINGS TO A SUBSTRATE. Elyutin, V. P.; Kostikov, V. I.; Shesterin, Yu. A. Fiz. Khim. Obrab. Mater., No. 3, 46-9(May-June 1969). (In Russian).

The mechanism underlying the adhesion of plasma coatings (Mo, W, Nb, Ta, Ti, Ni, and Cu) to substrates (Ta, W, Mo, and Cu) is discussed in the light of practical experience. In this process a considerable part is played by the interatomic forces acting between the different kinds of atoms, as well as by the temperature at the substrate/coating interface. A formula for calculating the interface temperature is derived. The contact temperature in fact constitutes a good criterion for the quality of the adhesion. Examples are given for a number of substrate/coating systems. (Metals Abstr.)

50996 DIRECT OBSERVATION OF OXIDATION OF ZIRCONIUM THIN FILMS AND ZIRCONIA THIN FILMS PRODUCED. Kitada, Masahiro; Koda, Shigeyasu (Tohoku Univ., Sendai). Nippon Kinzoku Gakkaishi, 33: 911-16(Aug. 1969). (In Japanese).

The oxidation phenomena of thin films of the reactor-grade pure zirconium and the behavior of thin films of produced zirconia were investigated by means of transmission electron microscopy. The oxidation of zirconium is carried out by electron beam heating in the electron microscope. It was found that when the specimen is heated gradually, small grains of monoclinic zirconia at first appear in a wide range of the thin film, and then, as a result of the increase in grain number and grain growth, the thin film of zirconium is entirely oxidized. Preferred oxidation near the grain boundary of zirconium is also observed. On the other hand, when the thin film of zirconium is heated strongly, the thin film changes rapidly to the pseudo-amorphous oxide at first, and then the monoclinic zirconia nucleates in the pseudo-amorphous oxide and grows into large grains. When the thin film of zirconium is oxidized instantaneously in air, the thin film changes into the monoclinic zirconia with a grain size of about 0.3 to 0.5 μ diameter. In the tetragonal zirconia, an active movement of dislocations and the presence of movable dislocation loops are observed. (auth)

50997 CORROSION OF TYPE 304 STAINLESS STEEL IN MIXED ANHYDROUS NITRIC AND SULFURIC ACIDS. Viebrock, J. M. (Battelle-Northwest, Richland, Wash.). Contract AT(45-1)-1830. Corrosion, 25: 371-9(Sept. 1969).

The corrosion behavior of Type 304 stainless steel was investigated in anhydrous HNO_3–H_2SO_4 solutions at temperatures from 50 to 100°C. The HNO_3 concentration ranged from 0 to 100 percent by weight. Type 304 stainless steel corrosion rates were determined by gravimetric analysis and by measuring the relative loss of the constituent materials, such as iron, chromium, nickel and manganese, using atomic absorption spectrometry. The corrosion rate was found to increase with HNO_3 concentration until a composition of 20 weight percent HNO_3 is reached. After this point, the corrosion rate decreases with the addition of HNO_3 to a minimum at 90 weight percent HNO_3–10 weight percent H_2SO_4. Increasing the HNO_3 concentration beyond this point rapidly increases the corrosion rate. The corrosion rates measured gravimetrically were substantiated by analysis of the elemental constituents in solution. (auth)

50998 GRAIN BOUNDARY GROOVING MEASUREMENT OF THE EFFECTIVE SOLUBILITY OF STAINLESS STEEL IN SODIUM. Hopenfeld, J. (Atomics International, Canoga Park, Calif.); Robertson, W. M. Contract AT(04-3)-701. Corrosion, 25: 365-6(Sept. 1969).

Investigations of stainless steel solubility in sodium at 400 to 650°C are reported. The average effective coefficient of diffusion was found to be $8.1 \pm 6.5 \times 10^{-3}$ ppM by weight. (J.R.D.)

50999 TECHNIQUE FOR STUDYING THE KINETICS OF INTERGRANULAR CRACK NUCLEATION ON AISI TYPE 304 STAINLESS STEEL IN OXYGENATED WATER AT 289 C. Wilde, B. E. (Vallecitos Nucleonics Lab., Pleasanton, Calif.). Corrosion, 25: 359-65(Sept. 1969).

The design of a system with which to study the kinetics of intergranular crack nucleation on Type 304 stainless steel in water containing 100 ppM O_2 at 289°C is described. A bellows loading system capable of holding samples in simple uniaxial tension is discussed, and the results of constant load experiments on sensitized Type 304 stainless steel are presented. The elongation-time behavior of the material is characterized by a distinct stair-step type of curve which is taken to indicate the presence of a mechanical event in the cracking mechanism. The nucleation or induction time, T_n, is shown to increase markedly as the applied stress was decreased from 30 to 20 kpsi. Cathodic protection inhibits crack initiation indefinitely, thereby indicating the presence of an electrochemical event in the cracking mechanism. Crack nuclei are shown to be associated with regions of plastic deformation, and can in certain instances initiate and propagate transgranularly down carbide decorated slip traces. (auth)

51000 OXIDATION RESISTANCE IN AIR OF MOLYBDENUM- AND CHROMIUM-BASE ALLOYS WITH $ThAl_2$, $ThSi_2$, AND USi_2. Badaeva, T. A.; Dashevskaya, L. I. pp 118-23 of Fiziko-Khimiya Splavov i Tugoplavkikh Soyedineniy s Toriyem i Uranom. Moscow, Izdatel'stvo Nauka, 1968. (In Russian).

The oxidation resistance in air of alloys with molybdenum and chromium disilicide bases was investigated. The most resistant of the investigated compounds were those of thorium and uranium with aluminum and silicon ($ThAl_2$, $ThSi_2$, and USi_2). It is shown that the alloys with a molybdenum disilicide base with 1 and 2 mol % $ThAl_2$ and 5 mol % $ThSi_2$ are most resistant. The alloys with 1 and 2 mol % $ThAl_2$ did not show visible signs of disintegration at 1100°C. Likewise, the alloys with 1, 2, and 5 mol % $ThSi_2$ did not show any signs of disintegration under similar conditions. The specimens were covered with a strong glass-like film. The alloys represent solid solutions with a molybdenum disilicide base. (JPRS)

51001 CORROSION OF METALLIC MATERIALS IN THE PROCESS OF GASEOUS DIFFUSION. Dixmier, J.; Hasson, R.; Maraval, S.; Salle, P.; Vincent, L. (CEA, Paris). pp 197-209 of Problemi della Separazione Isotopica dell'Uranio. Roma, Comitato Nazionale Energia Nucleare, 1968. (In French).

From Symposium on Problems Bearing on Isotope Separation of Uranium, Turin, Italy. See CONF-681015.

Studies were made on the corrosion of metals such as Ag, Ni, stainless steel, and Fe by UF_6. External and internal factors, such as isothermal corrosion, temperature, pressure, purity of the gas, purity of the metal, strains, and choice of materials are discussed. Products of the reaction are also briefly discussed. (P.C.H.)

51002 INTERACTION BETWEEN OXYGEN AND TUNGSTEN. Ageev, V. N.; Ionov, N. I. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekh. Fiz., 38: 1149-56(July 1968). (In Russian).

Results of an investigation of the formation kinetics of tungsten oxides are reported. In the experiments, the adsorbent (a tungsten ribbon was located directly at the ion source of a pulsed time-of-

flight mass spectrometer. The oxides desorbed from the ribbon during the flash passed through an ion source and were ionized by electrons. The relative number of oxygen ions in the flash was 10 to 12%, corresponding to partial low-temperature desorption of the atomic oxygen from the ribbon. Thermodesorption of the tungsten oxide was observed only after more than a single-layer oxygen coating was adsorbed on the surface. Two phases of thermodesorption of the oxides were observed during the flash, indicating that there are two different ways of tungsten oxidation, one of which is connected with diffusion penetration of the oxygen atoms from the absorbed layer over the surface layer of the tungsten atoms. The results show that, within the limits of a single-layer coating, the thermosorption of the oxygen from carbon-free tungsten occurs predominantly in the form of molecules, and only partially in atomic form, and the oxides are formed predominantly in the form WO_2 and WO_3. A model of the interaction of oxygen with tungsten is presented. (JPRS)

51003 OXIDATION OF METALS AND ALLOYS. PART 2. OXIDATION OF METALS BY ATOMIC AND MOLECULAR OXYGEN. Dickens, P. G.; Heckingbottom, R.; Linnett, J. W. (Oxford Univ.). Trans. Faraday Soc., 65: 2235-47(Aug. 1969).

The effect of atomic oxygen in the oxidation behavior of some fourteen metals—Ni, Co, Fe, Cu, Ag, Au, Pd, Pt, Zr, Al, Ta, Sn, Zn and Cd—was investigated. The reactions were followed gravimetrically, using a Sartorius microbalance; measurements were made over the temperature range 25 to 750°C. Atomic oxygen enhanced the rate of oxidation of metals which formed a single p-type oxide (e.g., Ni) but had little or no effect if the oxide scale was n-type, e.g., ZrO_2, or composed of several oxides, e.g., FeO + Fe_3O_4 + Fe_2O_3. These results are explained in terms of Wagner's theory of oxidation, which is extended to include the effect of atoms in the gas phase. Atomic oxygen also increased the rate of reaction when the rate-limiting step was at the gas/oxide interface, e.g., in Cu oxidation, and with silver it caused extensive oxidation where none was detected using molecular oxygen. (auth)(UK)

51004 PROTECTION OF BERYLLIUM AGAINST OXIDATION. Darras, Raymond; Dewanckel, Bernard; Leclercq, Daniel (to Commissariat a l'Energie Atomique). British Patent 1,168,253. Oct. 22, 1969. Priority date Aug. 1965, France.

A method of protecting Be and Be alloys against corrosion by high temperature oxidizing atmospheres is described. The Be or alloy is coated with a deposit of Mg, or Mg alloys with Ca or Be by electrolysis or metallizing. (J.R.D.)

Preparation and Fabrication

Refer also to abstracts 50987, 50995, and 52356.

51005 (BM-RI-7308) PREPARATION OF RARE-EARTH AND YTTRIUM METALS BY ELECTRODEPOSITION AND VACUUM DISTILLATION OF ALLOYS. Morrice, Edward; Murphy, J. E.; Wong, M. M. (Bureau of Mines, Reno, Nev. Reno Metallurgy Research Center). Oct. 1969. 11p.

Gadolinium, dysprosium, and yttrium are difficult to electrowin as high-purity liquid metals because of their high melting points (>1,300°C). Samarium metal is difficult to prepare directly by electrolysis because the metal reacts with the electrolyte. Rare-earth metals were electrodeposited on solid manganese, chromium, or iron cathodes to form low-melting alloys. The alloys were vacuum distilled to separate the rare-earth metals from the ferrous metals. A typical samarium metal product, obtained as the distillate from vacuum distillation of a samarium–iron alloy, contained 150 ppM oxygen, 80 ppM carbon, and 50 ppM iron as impurities. Gadolinium metal, obtained as a residue from the distillation of a gadolinium-chromium alloy, contained 300 ppM oxygen, 200 ppM carbon, and 100 ppM chromium. (auth)

51006 (BNWL-1129) FABRICATION OF SWELLING RESISTANT URANIUM METAL FUEL RODS FOR THE CANADIAN WHITESHELL REACTOR, WR-1. Gurwell, W. E.; Correy, T. B.; Vining, J. O. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Aug. 1969. Contract AT(45-1)-1830. 94p. Dep. CFSTI.

Metallic uranium has properties that make it an attractive fuel material for organic-cooled reactors, where the consequences of fuel rupture are not nearly so severe as in water-cooled reactors. Uranium swelling can be accommodated by a properly designed internal void. Studies were made on an optimum fuel design that had center temperatures in the 500 to 700°C range and average exposures of 7000 MWd/ton. One hundred thirty-four fuel rods with various combinations of void volume, geometry, and cladding thickness were fabricated for the experiment. Half of the rods were pellet filled and one-half were coextruded. A technique for coextruding fuel rods with small axial holes one-eighth inch in diameter was demonstrated to be economically feasible. (auth)

51007 (ORNL-TM-2694) FEASIBILITY STUDY ON REDRAWING TO PRODUCE USABLE TANTALUM TUBING. Reimann, G. A. (Oak Ridge National Lab., Tenn.). Oct. 1969. Contract W-7405-eng-26. 16p. Dep. CFSTI.

A procedure was developed to salvage defective tantalum tubing for conversion into a slightly smaller size tubing having acceptable quality. A combination of chemical polishing and mandrel drawing was demonstrated to be a satisfactory procedure. (auth)

51008 (SCL-T-69-251) ELECTROCHEMICAL PREPARATION OF AN INDIUM–GALLIUM ALLOY. Repinskii, S. M.; Medvedeva, I. E.; Varlamova, N. I. Translated by A. M. A. Mincer for Sandia Labs., Albuquerque, N. Mex., from Elektrokhimiya, No. 10, 1208-9(1967). 4p. Dep. CFSTI.

Studies were made on the dependence of the composition of the electrochemical deposits on the current density, temperature, and composition of HCl solutions of In and Ga. Germanium plates freshly etched in H_2O_2 served as the cathode, and the anode was a plate of platinum. The Ga content in the deposit increased monotonically with the current, and also increased with increasing solution temperature at current densities above 200 ma/cm^2. At low current densities (10 ma/cm^2) when practically pure In was deposited, the current efficiency was 100%. At current densities of about 300 ma/cm^2 the current efficiency calculated on the alloy was lower, but it did not fall below 80%. Large, slightly streamline-shaped crystals of the Ga–In alloy appeared at higher current densities. (J.C.W.)

51009 (Y-1696) HOMOGENIZATION EVALUATION OF A CAST URANIUM–MOLYBDENUM ALLOY. Coughlen, C. P.; Evans, P. A.; Townsend, A. B. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). Oct. 6, 1969. Contract W-7405-eng-26. 17p. Dep. CFSTI.

Studies have been made on the uranium-10 weight percent molybdenum alloy to determine the method and parameters of heat treatment for homogenization, the method and results of tensile testing the treated alloy, and the results of metallography performed on the material. In addition, metallography was performed on stock from the wrought alloy which demonstrated lack of homogeneity. (auth)

51010 THE FUEL CYCLE: PLANNING AND PROGRAMMING BY THE CNEN. Salvetti, Carlo (CNEN, Rome). Com. Naz. Energ. Nucl., Notiz., 15: No. 1, 21-6(Jan. 1969). (In Italian).

The individual components of the production of fuel elements by the CNEN are briefly described. These steps include procurement of the uranium, conversion of the ores into uranium, isotopic enrichment, design and fabrication of fuel elements, and reprocessing of the spent fuel. (J.S.R.)

51011 PRODUCTION OF UO_2 FUEL ELEMENTS FOR MASURCA. Tinjod, M.; Chevy, M. Ind. At., 13: No. 5-6, 65-6(1969). (In French).

Fuel elements for the Masurca critical assembly at Cadarache consist of UO_2 pellets placed in a stainless steel sheath. The ends of the sheath are closed by electron beam welding. The steps in the fabrication of these fuel elements and the machines designed for this production are briefly described. (J.S.R.)

51012 MOLYBDENUM ALLOY CORES FOR DIE CASTING. Petrichenko, A. M.; Goryunov, I. I.; Krylov, V. I. Liteinoe Proizvod., No. 5, 1-2(May 1969). (In Russian).

The use of Mo alloy (TZM, containing Ti 0.5 and Zr 0.08%) for cores in the production of Al alloy die castings is described and compared with the results obtained with 4Kh5MFS steel cores. A marked increase in core life and reduced costs were obtained by the use of the Mo alloy cores. (Metals Abstr.)

51013 CURRENT INDUSTRIAL POSITION OF SOME SPECIAL METALS. III. METALLURGY OF BERYLLIUM, NIOBIUM, AND TANTALUM. Logerot, J. M. Mec. Elec., 52: No. 232, 23-30 (Apr. 1969). (In French).

A brief review of the production and uses of Be, Ta, and Nb is presented. Subjects covered include: occurrence; extraction and refinement; powder metallurgy production; the chemical, mechanical and health problems encountered in working with Be; physical and mechanical properties; the effect of impurities on the various properties of Nb and Ta; the chemical properties of Nb; and the effects of alloying on the properties of Nb. The fabrication and uses of these metals are described, with particular emphasis on dimensional accuracy and strength of the products. (Metals Abstr.)

51014 METHODS OF JOINING TUBES. Davies, David Charles; Cairns, Walter John (to U. K. A. E. A.) British Patent 1,163,583. Sept. 10, 1969. Filed June 1, 1967.

Reference is made to methods of joining reactor pressure tubes in a fluid-tight manner, and disadvantages of present techniques for this purpose are enumerated. The method described, for end joining a Zr alloy tube and a steel tube, comprises forming internal annular grooves or serrations in one end region of the bore of the steel tube, inserting one end of the Zr alloy tube into the grooved or serrated end region of the steel tube, and heating and internally roll swaging the overlapped portions of the tubes to deform the Zr alloy tube into engagement with the steel tube and its grooves, the temperature roll swaging being sufficient to reduce the yield strength of only the Zr alloy. A loosely fitting support collar may be placed around the grooved or serrated end of the steel tube before swaging, sufficient clearance being provided between the steel tube and the support collar so that the steel tube is elastically strained into local support contact with the collar by the radially outward force exerted through the swaging rollers. The swaging temperatures may be in the range 100 to 400°C (preferably 250°C). (UK)

51015 EXPERIENCE IN EXPLOSIVE FORMING OF REFRACTORY METALS. Medzyanovskii, E. B. Kuznechno-Shtampovochanoe Proizvod., No. 2, 25-7(Feb. 1969). (In Russian).

Advances in explosive forming of W and Mo are described. In view of the high brittleness threshold of these metals, preliminary heating of the original thin sheet and the use of hot sand as a medium during the explosive-forming process are particularly recommended. A typical sand temperature is 800°C. Parts made in this way have good mechanical properties and are relatively free from cracks and similar defects. (Metals Abstr.)

51016 ENERGISTIC MATERIALS. ENERGY TO THE BENEFIT OF AEROSPACE AND MANKIND. 13th National Symposium and Exhibit, Chicago, May 7–8–9, 1968. Science of Advanced Materials and Process Engineering Proceedings, Volume 13. Chicago, Society of Aerospace Material and Process Engineers, 1968. 482p. (CONF-680554). North Hollywood, Calif., Western Periodicals Company.

Thirty-five papers on energistic materials are included; separate abstracts were prepared for 5. The remaining 30 papers contain information on: ir heating techniques; uv curing of impregnated fabrics and rovings; internal electrical resistance heating of carbon reinforced composites; active characterization of materials; long life materials for spacecraft; single crystal flake reinforced composites; boron wing extension for F-111B aircraft; research and development programs for composites; fabrication of large sandwich construction cylinders without taper; designing optimum deep submergence hulls for satisfactory fabrication with collimated tape; welding and ultrasonic methods; methods for plating and creating metal shapes; static electricity control; new plastics; aerospace technology; direct conversion of thermal radiative and chemical energy into electricity; corrosion of silver-plated copper conductors; metal joints for electrical connector contacts; thin conformal coatings; sterilization and post sterilization effects on electronic components and materials; space grade silicones for high vacuum environments; and peaceful uses of aerospace technology. (J.C.W.)

For abstracts of individual papers see: 50993, 51017–51019, and 51152.

51017 WELDING AND PHASE REACTIONS IN THE SOLID STATE USING PULSE ENERGIES. Potter, Richard D. (General Dynamics, Fort Worth, Tex.). Sci. Advan. Mater. Process Eng. Proc., 13: 135-43(1968).

From 13th National Symposium and Exhibit, Chicago, Ill. See CONF-680554.

A study was made on solid-state joining of materials and phase reactions. Specially controlled pulsed energy was used during the study to produce solid-state welds by forming interatomic or intermolecular bonds across conjunctive interfaces without forming liquid fusion zones or developing undesirable heat-affected material. Phase studies showed instantaneous diffusion and reactions without melting, even between some materials that normally do not react together. Solid-state welds also have been made between dissimilar materials and between materials previously considered unweldable. Joint strengths for tensile lap shear ultimate strength and for tensile–tensile lap shear fatigue strength for these solid-state joints were higher than is normally possible with conventional welding processes. (auth)

51018 SELECTIVE PLATING IN AIRCRAFT MAINTENANCE AND MANUFACTURING. Rubinstein, Marv (Selectrons, Ltd., New York). Sci. Advan. Mater. Process Eng. Proc., 13: 145-68(1968).

From 13th National Symposium and Exhibit, Chicago, Ill. See CONF-680554.

Attempts to trace the history of selective plating as it winds in and out of the aerospace field are made and a number of newly developed applications both in military aerospace and peacetime work are discussed. (J.C.W.)

51019 CONTINUOUS GLASS COATING OF FINE METAL WIRES. Potter, Alan; Henning, J. E. (Lundy Technical Center, Pompano Beach, Fla.). Sci. Advan. Mater. Process Eng. Proc., 13: 417-30(1968).

From 13th National Symposium and Exhibit, Chicago, Ill. See CONF-680544.

A method has been devised for continuous coating, in air, of metal wires as small as one mil in diameter. Tungsten and beryllium wires can be coated with either borosilicate or other types of glasses for utilization as dipole elements in electronic countermeasure systems. The dielectric coating serves to modify the element's physical behavior and allows for a decrease in the metal thickness required for performance. For tungsten, the major advantage is a decrease in overall weight while in the case of beryllium, the glass substitutes for the expensive metal. Other advantages provided by the glass coating are increased thermal endurance by providing a barrier to rapid oxidation, along with increased chemical durability of the element. Protection is a function of the particular glass coating applied and this selection is primarily based on the metal behavior. Evaluation of the glass-metal (wire) composites under severe conditions has revealed good potential for the utilization of these materials in areas other than electronic countermeasures. (auth)

51020 INDUSTRIAL USES OF DEPLETED URANIUM. Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.), No. 76, 12-16(Mar.-Apr. 1969). (In French).

Depleted uranium can be used for biological shielding against x and γ radiation, transport and storage containers for radioactive materials, collimators for radiation sources, inertia masses for aeronautics, and absorption of vibrations by inertia. Forming of depleted uranium is outlined. Containers, γ radiography material, and inertia masses produced by the S.I.C.N. are briefly described. (J.S.R.)

51021 METHOD FOR RESISTANCE WELDING OF MOLYBDENUM. CLASS 21, NO. 210962. Ovchinnikov, S. E.; Yanovitskiy, S. E.; Matveyev, A. I. Izobret. Prom. Obraztsy, Tovarnyye Znaki, No. 7, 48(1968). (In Russian).

A method is described for resistance welding molybdenum in which an intermediate insert is placed between the welded surfaces. To improve the welding quality, increase efficiency, and reduce costs, titanium is used as the insert. (JPRS)

51022 METHOD OF ELECTROPLATING TUNGSTEN, MOLYBDENUM, AND STAINLESS STEELS WITH NICKEL. CLASS 48, NO. 211258. Kasatkin, Yu. S. Izobret. Prom. Obraztsy, Tovarnyye Znaki, No.7, 48(1968). (In Russian).

A method is described for electroplating tungsten, molybdenum, and stainless steels with nickel in an electrolyte containing nickel chloride and hydrochloric acid. To obtain nickel deposits up to 150 μ or more thick, firmly bounded to the substrate, nickel sulfate and sulfuric acid are introduced into the electrolyte. The composition of the electrolyte is as follows: 240 to 260 g/l nickel sulfate, 50 to 55 g/l nickel chloride, 30 to 32 ml/l sulfuric acid and 10 to 12 ml/l hydrochloric acid. The process is carried out at 45 ±2°C, 8 to 10 A/dm^2 current density, 21.5 kHz ultrasonic vibrations of the electrolyte, and 35 to 40 W specific power. (JPRS)

51023 DIFFUSION WELDING OF HETEROGENEOUS METALS. Kharchenko, G. K. Avtomat. Svarka, No. 4, 29-32(Apr. 1969). (In Russian).

Diffusion welding of heterogeneous metals is reviewed for welds without interlayer and with interlayer(s). The metals considered in the first group are: Mo/1Kh13 steel; Mo/St3 steel; Ti/Cu; Ti/Ni; and Ti/Fe. In the second group the metal/interlayer(s)/metal are: Ti/Nb/bronze; Ti/Nb/Ti; Ti/Nb–Cu/steel; Ti/V/1Kh18N9T steel; and Ti/V–Cu/1Kh18N9T steel. The work reviewed dates from the investigations of Perona et al. in 1960 until the present time. (Metals Abstr.)

51024 PRODUCTION OF MOLYBDENUM AND TUNGSTEN BY THE CARBONYL METHOD. Belozerskii, N. A.; Krichevskaya, O. D. pp 109-17 of Izdatel'stvo Nauka, 1967. (In Russian).

A carbonyl method for producing molybdenum and tungsten has been developed. Technical-grade tungsten hexachloride (90 to 98% WCl_6) and molybdenum pentachloride (96 to 98% $MoCl_5$) were mixed with the same weight of iron chips, compacted under pressure of 200 to 250 kg/cm^2 into pellets 20 to 25 mm in diameter, and synthesized in a reaction vessel. Conversion to tungsten or molybdenum carbonyls for single operation was 85% for WCl_6 and 67.5% for $MoCl_5$. Raw carbonyls were refined by steam distillation. The

impurity content in twice-refined carbonyls did not exceed 0.005%. This method made it possible to obtain high-purity tungsten and molybdenum at 20% lower cost as compared with conventional methods. (JPRS)

51025 HARD-FACING WITH NIOBIUM-CONTAINING ELECTRODES FOR HAND-WELDING IN SINTERPLANTS. Hense, L.; Zoethout, G. Iron Steel (London), 42: 81-7(Apr. 1969).

The properties and applications of Nb-containing hard-facing electrodes in sinterplants were investigated to develop an inexpensive weld metal with resistance to abrasion and impact by coke, ore, and sinter. Three electrodes with the following weld metal compositions were investigated: Type 1, 3 to 4% C, 22% Cr, 6% Nb; Type 2, 5 to 6% C, 22% Cr, 6% Nb; and Type 3, 5 to 6% C, 22% Cr, 6% Nb, 6% Mo, 1.5% W, and 1% V. Hard-facing deposits containing round Nb–Cr carbides were proved to be satisfactory in various conditions. (Metals Abstr.)

51026 PREPARATION OF $SmCo_5$ PERMANENT MAGNETS. Buschow, K. H. J.; Naastepad, P. A.; Westendorp, F. F. (Philips Research Labs., Eindhoven, Netherlands). J. Appl. Phys., 40: 4029-32(Sept. 1969).

The technology of making $SmCo_5$ magnets with energy products of 20×10^6 GOe is described. This technology consists of the preparation of a powder by grinding, aligning the powder particles in a magnetic field, and cold pressing by applying a uniaxial deformation at 20 kbar. The permanent magnetic properties of the $SmCo_5$ powders are shown to vary appreciably with various applied chemical treatments and with the composition of the alloy. The intrinsic coercive force appears to decrease with time but remains so large that the demagnetization of the induction is hardly affected. Some properties of the magnets are discussed. (auth)

51027 ELECTRODEPOSITION OF INDIUM. Rafaeloff, R. (Soreq Nuclear Research Centre, Yavne, Israel). Radiochem. Radioanal. Lett., 2: 93-9(Oct. 13, 1969).

The electrodeposition of indium has been investigated using a ^{114}In tracer, as a function of pH, cathode-to-anode area ratio, and cathode current density, in the concentration range of 10^{-1} to 10^{-7} M indium. Using a dilute sulfuric acid bath and a cathode current density of 1.2–1.8 A/cm^2, indium was electrodeposited quantitatively within a few hours. (auth)

51028 DEVICE FOR WELDING A PLUG ONTO THE END OF A NUCLEAR FUEL ROD. Tajima, Seisyo (to Tokyo Shibaura Electric Co.). Japanese Patent 1969-13247. June 13, 1969. Filed Dec. 20, 1966.

A device for welding a plug onto the end of a nuclear fuel rod is described that consists of a welding chamber with end lids, a means to evacuate the chamber, and a means to supply environmental gas to the chamber. The welding equipment incorporates welding rods adjustable and operable from the outside and a means to insert and support a fuel rod. The fuel rod is operated from outside and a means is provided to insert and support the plug. A means is also provided to rotate the supports of both fuel rod and plug. (NSA of Japan)

51029 A CONTROLLED COOLING PROCESS FOR SOLIDIFYING METAL CASTINGS, AND AN APPARATUS FOR PERFORMING THE PROCESS. Courcier, Philippe (to Compagnie Pour l'Etude et la Realisation de Combustibles Atomiques). British Patent 1,166,275. Oct. 8, 1969. Priority date Oct. 25, 1965, France.

A controlled cooling process for solidifying metal shapes cast at low pressure in a furnace is described in which the furnace is filled a short time after pouring with a fluid inert to the castings to be cooled. The fluid is then removed from the furnace, cooled, and reintroduced at a controlled rate. (J.R.D.)

Properties Evaluations

Refer also to abstracts 50029, 50034, 50196, 50205, 51063, 51067, 51113, 51796, 51804, 51805, 52208, and 52356.

51030 (AI-AEC-12834) STUDIES OF THE SOLUBILITY OF IRON IN SODIUM. Eichelberger, R. L.; McKisson, R. L. (Atomics International, Canoga Park, Calif.). Aug. 15, 1969. Contract AT(04-3)-701. 26p. Dep. CFSTI.

The solubility of iron in high-purity sodium was studied in the temperature range of 500 to 1000°C, using both unirradiated and irradiated iron as solute. No explanation was found for the variable divergence of colorimetric and radiochemical results, or for the relatively poor reproducibility, although the factors which may affect such experiments are discussed. The most probable value for the solubility of iron in sodium, in the temperature range studied, is of the order of 1 wppM, but the data do not permit a calculation of the temperature dependence. (auth)

51031 (BM-RI-7262) INTERACTIONS OF TITANIUM AND MOLYBDENUM ADDITIONS WITH INTERSTITIAL IMPURITIES IN VANADIUM. Keith, George H. (Bureau of Mines, Reno, Nev. Reno Metallurgy Research Center). May 1969. 22p. Bureau of Mines Free.

The mechanism(s) involved in observed anomalous changes in mechanical properties of vanadium-base alloys were determined. Tensile properties of electrorefined and commercial-purity vanadium-base alloys containing up to 5 atomic percent molybdenum or titanium were measured between 77 and 673°K. Snoek oxygen and nitrogen peak heights were measured to determine the changes in dissolved interstitial content caused by increasing quantities of solute. In addition, changes in lattice parameter were followed with precision x-ray techniques. Softening, observed in alloys containing titanium, is explained by the formation of a second-phase titanium compound with oxygen or nitrogen. However, because of partitioning of titanium between compound formation and solid solution formation, about five times the stoichiometric amount was required for complete reaction. Addition of 1% titanium drastically lowered the strengthening due to strain aging at 673°K, and 2% titanium essentially eliminated it. All alloys were ductile at 77°K. Variations in the tensile properties of the molybdenum-containing alloys are explained by variations in the amounts of interstitial impurities present. The molybdenum did not react with these impurities and had no effect on strengthening due to strain aging. Commercial-purity vanadium alloys containing more than 2% molybdenum were brittle at 77°K. (auth)

51032 (CEA-R-3715) INFLUENCE OF A HYDROSTATIC PRESSURE ON THE DIFFUSION IN METALS HAVING A CUBIC STRUCTURE. Beyeler, Michel (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). July 1969. 135p. (In French). Dep. CFSTI (U. S. Sales Only).

Thesis. Submitted to Paris Univ., France.

The activation volumes for self diffusion in face centered cubic metals: silver, gold, copper, aluminum, and in body-centered cubic uranium (γ phase), were determined by diffusion experiments under high pressure. Activation volumes for noble metal diffusion in aluminum have also been investigated. The experimental results on gold, silver, and copper were in good agreement with most of the theoretical models. The estimated activation volume for γ uranium seemed to indicate a vacancy mechanism. The results on aluminum for both self and impurity diffusion agreed quite well with Friedel's theoretical predictions. (auth)

51033 (GAMD-9623) CRECOL: A COMPUTER PROGRAM FOR ESTIMATING CREEP DEFORMATION OF SLIGHTLY OVAL TUBES. Hopkins, H. C.; Buttemer, D. R. (Gulf General Atomic, Inc., San Diego, Calif.). Aug. 1, 1969. Contract AT(04-3)-167. 53p. Dep. CFSTI.

The computer code CRECØL is described and background information on this code is included. CRECØL analyzes the creep-deformation with time of a slightly oval tube when subject to an external pressure. The code was developed to predict the behavior of the fuel rods in the gas-cooled fast reactor where minimizing clad wall thickness consistent with satisfactory performance is desirable. Only the material properties for Hastelloy X and 316SS in the unirradiated conditions are incorporated in this version. (auth)

51034 (JPRS-48743) VISCOSITY OF LIQUID BERYLLIUM. Milov, I. V.; Klimov, Yu. F.; Skorov, D. M. Translated from Izv. Akad. Nauk SSSR, Metal., No. 4, 82-3(1969). 4p. CFSTI.

The viscosity of liquid beryllium and its variation with temperature were determined. A hypothesis was advanced that the coarse grained structure of beryllium castings is chiefly due to the presence of quasicrystalline regions of significant dimensions in a beryllium melt near its crystallization temperature. (auth)

51035 (JUL-586-FN) CREATION OF DEFECTS IN COPPER AND ALUMINUM BY LOW TEMPERATURE ELECTRON IRRADIATION. Sassin, Wolfgang (Kernforschungsanlage, Juelich (West Germany). Institut fuer Festkoerper- und Neutronenphysik). Apr. 1969. 60p. (In German). Dep. CFSTI (U. S. Sales Only).

In order to clarify which processes determine the origin of high defect concentrations, samples of very pure Cu and Al were irradiated with 2.8-MeV electrons at temperatures below 9°K. A maximum irradiation dose of 1.15×10^{20} electrons/cm^2 could be obtained by direct cooling in flowing liquid helium. A step-wise thermal recovery of the Frenkel defects produced extensively in the form of narrowly neighboring pairs and brief test irradiations show that two different recombination processes during the defect creation reduce increasingly the measurable damage rate. In addition to the spontaneous recombination, which was caused by the

new production of a defect in the instability range of an existing defect, ZGA-LS pairs are also destroyed when sub-threshold collisions occur. The susceptibility with respect to sub-threshold recombinations is a characteristic for a given pair configuration and is decreased with increasing thermal stability. In contrast, the size of the spontaneous recombination volume is independent of the configuration of a Frenkel defect. The simultaneous formation of stage II, which does not occur in low electron doses in very pure Cu and Al, indicates the formation of interstitial atom and vacancy complexes, which are formed gradually during irradiation. The samples irradiated with electrons up to saturation show qualitatively the same recovery behavior as the samples irradiated with low doses of neutrons. (tr-auth)

51036 (KFK-987) INVESTIGATION OF SPECIAL MELTS OF THE ALLOY INCOLOY 800. Ehrlich, K.; Kramer, K.-H.; Schneider, W. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material und Festkoerperforschung). June 1969. 22p. (In German). Dep. CFSTI (U. S. Sales Only).

The effect of alloying elements on the mixed crystal or precipitation hardening was investigated in three alloy compositions. The first was the normal Incoloy 800; 3.1 wt.% W was added to the second, and 3 wt.% Mo, 3 wt.% W, and 2.7 wt.% Nb to the third. The results showed that only an insignificant mixed crystal hardening was caused by the addition of W or W, Mo, and Nb. Precipitation hardening occurs in the precipitation of quenched samples. In the alloy with 2.9 wt.% W the Fe_2W phase occurs, which causes only a slight hardening increase. The alloy with W, Mo, and Nb shows a strong hardening through the incoherent phase. The hardening maxima were obtained after precipitation for 130 to 1000 hr. Both the special alloys investigated were unsuitable for cladding materials. (J.S.R.)

51037 (RD/B/N-1448) METAL-COOLANT THERMAL INTERACTIONS AT HIGH TEMPERATURES: PRELIMINARY RESULTS FROM A LASER HEATING EXPERIMENT. Clare, A. J.; Duffey, R. B.; Hall, R. S.; Playle, T. S.; Poole, D. H. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Sept. 1969. 32p. (FRPMC/RSWP/P-(69)-191). Dep. CFSTI (U. S. Sales Only).

The significance of fuel-coolant thermal interactions in reactor safety is discussed and earlier experiments in this field are briefly reviewed. A pulsed laser was used to heat metal foil samples under water, and the resulting generation rates of water vapour were examined. The apparatus and techniques for measuring the various parameters of interest are discussed in detail. Preliminary results confirmed that the most significant parameters are the temperature of the foil and its degree of dispersion. A previously unreported phenomenon is described, which provides a mechanism for the support of hot metal particles above a liquid surface, with consequent low rates of energy transfer. (auth) (UK)

51038 (UCRL-71862) IMPROVEMENTS IN HOT MICROHARDNESS TESTING TO 1500°C. Landingham, R. L. (California Univ., Livermore. Lawrence Radiation Lab.). Sept. 2, 1969. 47p. (CONF-690920-2). Dep. CFSTI.

From 2nd Annual Technical Meeting of International Metallographic Society, San Francisco, Calif.

Dispersion-strengthened refractory metals were prepared by chemical co-vapor deposition and internal nitriding to improve their creep resistance. Preliminary screening of these materials by hot microhardness tests significantly reduced the number of costly creep test facilities and specimens. Hot microhardness values were correlated with amount, size, and distribution of the dispersoids in screening these materials. Several modifications in the commercially acquired hot microhardness tester were made during these screening tests to improve the precision of results. The modifications of the specimen holder, furnace, indenter rate controller, and vacuum system are described. The existing optical system was not modified since it met the needs of viewing and photographing the indentations up to 1500°C in vacuum. Difficulties above 1500°C are also discussed. (auth)

51039 (WARD-3791-38) VANADIUM ALLOY CLADDING DEVELOPMENT. Quarterly Progress Report for the Period Ending June 30, 1969. Bishop, E. C.; Nadler, R. A.; Whitlow, G. A. (Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.). Aug. 1969. Contract AT(30-1)-3791. 39p. Dep. CFSTI.

Work Performed under United States-Euratom Fast Reactor Exchange Program.

A summary of current progress is presented. Good yields of 0.500 inch OD × .050 inch wall tubing in the three VANSTAR alloys and the V-15Cr-5Ti alloy were obtained from the joint Westinghouse/ANL processing arrangement. Shipments of these materials were made to GENMPO and LASL. LASL and ORNL received shipments of 0.300 inch OD × 0.010 inch wall tubing. Characterization of representative samples of this tubing was completed. Sheet, 0.060 inch in thickness, was made available to LASL and MSAR. Metallographic and microhardness evaluations of vanadium alloy samples exposed to sodium in both of the loop systems were completed. Loop redesign was completed and reconstruction of the system is underway. Eight additional carbide fueled irradiation pins, each containing one vanadium alloy tensile/creep sample, were assembled. (auth)

51040 GENIE ATOMIQUE. TOME II. COURS FONDAMENTAL. (Nuclear Engineering. Volume II. Fundamental Course). Bibliotheque des Sciences et Techniques Nucleaires. Saclay, France, Institut National des Sciences et Techniques Nucleaires. Paris, Presses Universitaires de France, 1968. 402p.

A basic course in nuclear engineering is presented. The topics considered —each discussed by a different author —are fuels, moderators, structural materials, radiation detection, fuel elements, operation and control of a reactor, kinetics and control of nuclear power stations, general principles of radiation protection, technical means of radioprotection and their application to reactors, and protection shields for reactors. Each of these 10 sections is individually abstracted. (J.S.R.)

For abstracts of individual sections see: 49903, 50130, 50131, 50553, 51041-51043, 52284, 52492, and 52493.

51041 MODERATORS. Gauthron, M. pp 27-43 of Genie Atomique. Tome II. Saclay, France, Institut National des Sciences et Techniques Nucleaires. Paris, Presses Universitaires de France, 1968. (In French).

The principal moderators used in reactors are heavy water, graphite, beryllium, and beryllium oxide. The production of heavy water and its physicochemical properties are described. The fabrication of artificial graphite, its general properties, and the effects of fast neutrons are discussed, along with its compatibility with coolants. Be and BeO are briefly considered. (J.S.R.)

51042 STRUCTURAL MATERIALS. Bernard, J. L. pp 45-99 of Genie Atomique. Tome II. Saclay, France, Institut National des Sciences et Techniques Nucleaires. Paris, Presses Universitaires de France, 1968. (In French).

A general review is given on the properties required in structural materials with respect to the nuclear properties, mechanical properties, fabrication quality, and physicochemical properties. The effects of radiation on the mechanical and physicochemical properties is also considered. The principal structural materials are Al and its alloys, Mg and its alloys, Be, Zr and its alloys, and steel. (J.S.R.)

51043 FUEL ELEMENTS. Gauthron, M. pp 101-33 of Genie Atomique. Tome II. Saclay, France, Institut National des Sciences et Techniques Nucleaires. Paris, Presses Universitaires de France, 1968. (In French).

The constitution of a fuel element, the form of the fuel element, technological performance, compatibility conditions, and fuel-cladding interactions are the characteristics used to classify fuel elements into four general types. Type 1 is a low-cost natural uranium element, easy to declad, for the simultaneous production of electrical energy and Pu, used in the G-2 reactor at Chinon. Type 2 is a moderately priced slightly enriched fuel element with UO_2 used for naval propulsion, power reactors, and fast reactors. Type 3 is a highly enriched element for high flux research reactors (MTR) or for submarine propulsion. The fuel material is dispersed in a metallic matrix. Type 4 is a highly or moderately enriched element for very high temperature reactors with high yield. The fuel material is dispersed in a ceramic matrix. The characteristics of each of these fuel element types are discussed. (J.S.R.)

51044 MIGRATION OF EQUILIBRIUM GAS BUBBLES IN A SOLID SUBJECT TO A STRESS GRADIENT. Martin, D. G. (Atomic Energy Research Establishment, Harwell, Eng.). J. Nucl. Mater., 33: 23-9(Oct. 1969).

An analytical expression is derived for the force which acts on an equilibrium bubble in a solid due to a stress gradient. This differs appreciably from previously published expressions; in particular, contrary to previous conclusions, it is predicted that bubbles will be driven to regions of lower stress, irrespective of whether the solid is under compression or tension. This driving force is evaluated in a number of cases and its magnitude compared with that arising as a result of a temperature gradient. (auth)

51045 SECONDARY CREEP OF ANISOTROPIC NUCLEAR MATERIALS. Schroeder, J.; Holicky, M. J. (Univ. of Waterloo, Ont.). J. Nucl. Mater., 33: 52-63(Oct. 1969).

Discrepancies in the correlation of in-reactor creep rates measured on both uniaxial specimens and reactor pressure tubes made of cold worked zirconium alloys were analyzed. An in-reactor creep theorem for anisotropic zirconium alloys is proposed which holds that for differences in creep moduli of approximately 20%, diametral creep rates of anisotropic pressure tubes may be twice or one half as high as diametral creep rates of isotropic tubes if the uniaxial creep rates are proportional to about the third power of stress. Using the limited test results available for both uniaxial and diametral in-reactor creep of cold worked zirconium alloys, it is shown at least qualitatively that experimental results of both uniaxial specimens and pressure tubes can be correlated in accordance with the theorem proposed for anisotropic creep assuming a variation of the power-index or of the anisotropy coefficients with stress. Suggestions for further work are indicated. (auth)

51046 EFFECT OF HUMIDITY ON THE LOW TEMPERATURE TENSILE PROPERTIES OF URANIUM. Hughes, A. N.; Orman, S.; Picton, G.; Thorne, M. A. (Atomic Weapons Research Establishment, Aldermaston, Eng.). J. Nucl. Mater., 33: 99-100 (Oct. 1969).

Analysis of data on the ductile-brittle behavior of U at −75 to 175°C revealed that water vapor affects the tensile properties at subzero temperatures. The low temperature ductility of U thus affected by water vapor is believed to develop either by stress-corrosion cracking or by hydrogen-embrittlement. (J.R.D.)

51047 INFLUENCE OF THE TEST CONDITIONS ON THE MECHANICAL PROPERTIES OF THE ALLOY VN-2. Kidin, I. N.; Medvedev, V. V.; Mochalov, B. V. Izv. Vyssh. Ucheb. Zaved., Chern. Met., 3: 123-6(Mar. 1969). (In Russian).

The influence of the test atmosphere on the mechanical properties of the cold-worked Nb-base alloy VN-2 was investigated for non-stationary heating schedules. The atmospheres were a vacuum of 10^{-3} torr or an environment of 25% CO_2 and 75% N at 300 torr. Deformation temperature curves for specimens heated continuously in the two atmospheres showed that the same deformation is reached at a lower temperature vacuum, for otherwise equal conditions. Deformation/temperature curves are plotted for tests in the $CO_2 + N_2$ gas at different heating rates under constant load, and for different loads at the same heating rate. (Metals Abstr.)

51048 CURRENT INDUSTRIAL POSITION OF SOME SPECIAL METALS. IV. THE COPPER–BERYLLIUM ALLOYS. Coupry, J. Mec. Elec., 52: No. 232, 31-7(Apr. 1969). (In French).

The properties and applications of Cu–Be alloys are briefly described, with particular reference to recent metallurgical advances. The usual thermal treatment, and microstructures, of the alloys Cu–2% Be, Cu–1.7% Be, and Cu–2.5% Co–0.5% Be are outlined, their physical properties, the effect of tempering temperature on the magnetic susceptibility of Cu–2% Be and on the electrical conductivity of all three alloys, mechanical properties after various heat treatments, mechanical strength at high and low temperatures and fatigue strength are discussed. Their production and fabrication, and available semi-fabricated products are described. (Metals Abstr.)

51049 PHYSICO-MECHANICAL PROPERTIES OF THE CORROSION-RESISTANT ALLOY 47KhNM HAVING HIGH ELASTIC PROPERTIES. Krasnopevtseva, T. V.; Paretskaya, R. M. Sb. Tr. Tsent. Nauch.-Issled. Inst. Chern. Met., No. 64, 90-9(1968). (In Russian).

A new non-magnetic dispersion hardened [Cr–Ni–Mo] alloy 47KhNM is described for elastic sensitive elements and springs. This is distinguished from alloys of a similar type, e.g., EI 702 [Ni 35.6, Cr 12, Mn 0.8, Al 1.5, Ti 3.0, and Fe remainder], etc., by having a corrosion resistance towards aggressive media containing concentrated HNO_3 which is appreciably (~10 times) higher. (Metals Abstr.)

51050 VARIATION OF THE YIELD STRESS IN Fe–7 AT PERCENT Mo ALLOY AT LOW TEMPERATURES. Sakuma, Taketo; Karashima, Seiichi (Tohoku Univ., Sendai). Scr. Met., 3: 699-702(Oct. 1969).

Tests were conducted with Fe–7 at.% Mo to determine whether softening behavior observed in this alloy is caused by changes in the density of mobile dislocations, or a modification of rate-controlling mechanism. Results are presented that show that the data on quenched Fe–7 at.% Mo cannot be explained by changes in dislocation density alone. (J.R.D.)

51051 LIGHT ALLOYS FOR THE NEW TECHNOLOGY. Fridlyander, I. N. Vestn. Akad. Nauk SSSR, No. 8, 95-106 (1968). (In Russian).

Aluminium, magnesium and beryllium light alloys play an important part in modern technology. Aluminum alloys are extensively used in aircraft structures. Most of the Soviet high-strength aluminum alloys, such as V95, V96 and V93, belong to the aluminum–zinc–magnesium system, but contain some modifiers such as chromium, magnesium, and iron in order to reduce the intrinsic susceptibility of aluminum–zinc–magnesium alloys to delayed cracking. V95 alloy has been successfully used in Tu-104, Tu-114 and AN aircraft wings. V93 alloy was developed primarily for use in "Athens" aircraft whose design incorporates huge forgings weighing up to five tons. These forgings required good quality ingots up to 1100 mm in diameter. Two lithium-containing alloys VAD23 and 01420 have been developed. Both, especially 01420, promise significant weight savings. For instance, the use of VAD23 in the Tu-144 supersonic airliner would yield a weight savings of 10% as compared to the AK4-1 type alloy used in the French-British "Concord" airliner. With the use of 01420 alloy, which has a lower density and a higher limit of elasticity, a weight savings of up to 20% could be achieved. Several sintered aluminum alloys have been developed. These alloys are made of tiny granules obtained by atomizing molten alloys containing alloying elements in amounts much higher than their limit of solid solubility in aluminum. Water-quenched particles of aluminum-chromium alloy retain as much as 2% of chromium in solid solution. Sintered alloys made of these particles have a tensile strength of up to 50 kg/mm² at an elongation of up to 1%. Sintered aluminum–magnesium–chromium alloy has a tensile strength of 45kg/mm² and a high corrosion resistance. This alloy is believed to be an excellent ship-building material, especially for hydrofoil craft. Sintered SAS-1 alloy (25% silicon, 5% nickel) has a high modulus of elasticity and a low coefficient of linear expansion, approaching that of steel. It is used in high-precision instruments. Significant progress has been made with SAP (sintered aluminum powder) materials. Several binary beryllium–aluminum alloys have been developed. These alloys have low strength. However, the strength can be improved by strengthening the aluminum matrix with elements which do not react with beryllium. Some ternary and quaternary beryllium alloys have been developed. At a beryllium content of 70 to 80% these alloys have high strength and modulus of elasticity at a satisfactory ductility but the melting and plastic working of these alloys presents serious difficulties. Nevertheless, methods of melting, extracting, rolling and die-forging have been developed. The development of new beryllium alloys is hampered by the absence of phase diagrams of ternary and more complex systems involving beryllium. Intensification of research and development work in this field is required. (JPRS)

51052 STRUCTURAL CHANGES IN A SUBSTANCE UNDER THE ACTION OF LIGHT LASER PULSES. Iyerusalimskaya, A. N.; Samoylov, V. I.; Ulyakov, P. I. Fiz. Khim. Obrab. Mater., No. 4, 26-34(1968). (In Russian).

Special features of the destruction of various metals and dielectrics by laser radiation with energies of the order of hundreds of joules in a pulse were studied. Metallographic analysis was carried out for 24 industrial pure metals and alloys: AV000 aluminum and its alloys, iron, iron ceramics, and different types of steel (20, 30KhGSA, EI-867, 1Kh18N10T, and others), copper, lead, titanium and its alloys, nickel, magnesium, zinc, niobium, molybdenum, tungsten, and several others. Part of the metals were tested in states such as untreated, annealed, and quench-hardened. The tungsten and the iron ceramic were obtained by sintering from powder. The pulse energy in each experiment was measured in an IF68 calorimeter. The light pulse, with energies from 100 to 400 joules, consisted of irregularly succeeding parts of random amplitude and had a total duration of about 2.5 milliseconds. Such a pulse, with a mean current density of the order of 10^7 W/cm², produces local destruction and ejection of the material, forming a crater with a depth of several millimeters. Structural changes in the metal were determined within a narrow zone adjacent to the crater. The thickness of the layer in which the initial structure changes does not exceed fractions of a millimeter. For all the metals, traces of the melt were observed on the inner surfaces of the crater. The thickness of the layer of prismatic crystals from the melt on the side surface increases approximately uniformly from the bottom to the top of the crater. For iron, for example, at the edge of the crater, the thickness of the layer reaches 100 microns. Several of the metals exhibit only one layer with a changed structure. The thinnest and most unchanged layer is formed on the surface of the crater in niobium, molybdenum, and titanium. (JPRS)

51053 STUDIES ON [100] SLIP IN Fe–2 PERCENT V ALLOY SINGLE CRYSTALS. Takeuchi, Shin (National Research Inst. for Metals, Tokyo). Jap. J. Appl. Phys., 8: 1205-10(Oct. 1969).

In an attempt to measure the critical resolved shear stress for ⟨100⟩ slip of bcc metals, Fe–2%V single crystals were compressed along [110] direction, constraining the side faces, (001) and (00$\bar{1}$), with a pair of fixed walls. Under these conditions, all ⟨111⟩ slips are geometrically expected to be suppressed, and consequently

[100] or [010] slip will be activated. Electron microscope study on specimens compressed in the above mentioned manner, however, showed no sign of (100) slip being activated and it was concluded that at room temperature the critical resolved shear stress for (100) slip was over an order of magnitude higher than that for (111) slip. (auth)

51054 HIGH-ENERGY EQUIPMENT FOR RADIOGRAPHY OF HEAVY-GAGE MATERIALS. Bonazzo, E. (Breda Termomeccanica e Locomotive, Milan). Atti Notiz. (Publ. in Met. Ital.), 24: 113-26(Apr. 1969). (In Italian).

The increase of the thicknesses of steel structures controlled by radiography has made it necessary to design radiographic apparatus with high energy in order to increase the upper limits of the thicknesses that can be radiographed. The high-energy radiographic apparatus in common use was analyzed from the physical and operational viewpoint. Some analytical problems inherent in the problems of biological protection for this type of apparatus are reported and analyzed. (tr-auth)

51055 DISLOCATION HELICES IN MOLYBDENUM. II. PLASTIC DEFORMATION BY MOVING HELICES. Pegel, B.; Becker, C. (Zentralinstitut fuer Festkoerperphysik und Werkstofforschung, Dresden). Phys. Status Solidi, 35: 157-66 (Sept. 1, 1969).

A description and theoretical discussion of an experiment is given where the plastic deformation of a molybdenum specimen is entirely due to dislocation helices moving along their glide cylinders and leaving, as the final dislocation state, arrays of parallel screw dislocations. (auth)

51056 THERMOELECTRON EMISSION OF PYROLYTIC COVERS FROM ZrC AND W. Matskevich, T. L.; Krachino, T. V.; Vil'k, Yu. N.; Davydov, V. S. (Leningrad Inst. of Physics and Tech.). Zh. Tekh. Fiz., 38: 1379-84(Aug. 1968). (In Russian).

An experimental investigation was made of thermoelectric emission of pyrolytic coatings of ZrC on ZrC, of tungsten on ZrC, and of tungsten on tungsten in the temperature range 1300 to 2800°K. The thickness of ZrC coatings was 100 μ and that of the tungsten was 15 to 30 μ. The investigations were carried out in cylindrical diodes, whose working and guarding anodes had a temperature not higher than 800°K. The measurements were made by static and pulsed methods in a vacuum of 10^{-8} mm Hg. From the Schottky curves obtained in the indicated regions, it was found that the currents that can be drawn from cathodes with pyrolytic coating of ZrC at 2800°K can reach 130 A/cm^2 with a zero field at the cathode, and when the field is 1.2×10^5 V/cm, these currents can reach 240 A/cm^2. The density of the thermionic emission current from the surface of pyrolytic tungsten deposited on ZrC, after low-temperature heating in vacuum, was close to that of ZrC. The deposition of a tungsten on ZrC can greatly decrease the rate of evaporation of the ZrC, without changing significantly its thermal properties up to a temperature of 2500°K. The individual microcrystals of the investigated coatings had no preferred orientation. After heating in vacuum, regular steps, 230 A in size, were observed on the surface of the ZrC grains. (ATD)

51057 THREE DUCTILE COPPER-BERYLLIUM ALLOYS. van Zanden, H. G. Constructiematerialen, 3: No. 4, 18-21(Apr. 1969). (In Dutch).

Cu-Be alloys are available in strip, rod and wire form; the main types being CuBe 1.7, CuBe 2, and CuCoBe (DIN 17666). The CuBe 1.7 has high tensile strength, good conductivity, is non-magnetic, and non-sparking. CuBe 2 in addition has high fatigue and wear resistance, while CuCoBe can be worked at high temperatures. All three alloys have good spring properties. The alloys are slightly less corrosion resistant (as determined by the salt spray test) than Cu, but are more resistant than phosphor bronze, 70:30 brass, Al-bronze, 18:8 stainless, or spring steel. The physical properties, tensile/conductivity comparison, and % compositions of the alloys are given, and the effects of heat treatment on the room temperature mechanical properties illustrated. Applications include electrotechnological, electronics, plastic and light metal extruders, spark free components, and watch and clock manufacture. (Metals abstr.)

51058 IMPROVEMENTS IN OR RELATING TO MAGNESIUM BASE ALLOYS. Gitlesen, Gunnar (to Norsk Hydro-Elektrisk Kvaelstofaktieselskab). British Patent 1,163,200. Sept. 4, 1969. Filed Jan. 30, 1968.

Mg-base alloys containing Al and Ca possess a high resistance to creep at temperatures between 200 and 250°C and are useful in structural components of nuclear power plants. The alloys, however, show a tendency to hot cracking on casting, and particularly upon pressure die casting. It was found that this tendency could be significantly lowered if the Zn content was reduced to a much lower level, a maximum Zn content of 0.3%. Zn is desirably present due to the good effect it has on the general casting properties of the alloy. Very satisfactory alloys were obtained containing 2 to 10% Al, 0.001 to 0.5% Mn, 0.5 to 2.5% Ca, up to 0.5% Cu, up to 0.5% Si, and up to 0.3% Zn. A number of such alloys were prepared and tested. The alloys could be made oxidation-resistant by incorporation of small quantities of Be. (UK)

51059 EFFECT OF SMALL ADDITIONS OF TITANIUM AND ZIRCONIUM ON THE STRUCTURE AND MECHANICAL PROPERTIES OF SOLID SOLUTIONS OF GERMANIUM IN COPPER. Nikol'skaya, I. M.; Shpicinetskii, E. S. Tr. Gos. Nauch.-Issled. Proekt. Inst. Splavov Obrab. Tsvet. Metal., No. 27, 7-10(1968). (In Russian).

Small additions of Ti and Zr appreciably raise the ductility of Cu-Ge alloys at elevated temperatures. Under certain crystallization conditions there is also decreased branching of dendrites in the presence of small additions of Zr. (Referativnyi Zh.)

51060 USTALOST' I KHRUPKOST' METALLICHESKIKH MATERIALOV. (Fatigue and Brittleness of Metallic Materials). Ivanova, V. S.; Gurevich, S. E.; Kop'ev, I. M.; Kudryashov, B. G.; Stelanov, B. N.; Mar'yanovskaya, T. S.; Nikonov, A. G.; Ustinov, L. M. Moscow, Izdatel'stvo Nauka, 1968. 216p.

Contemporary methods for the evaluation of the tendency of metals to brittle failure, the effects of static and cyclic loads on the propagation of cracks, failure under the action of cyclic loads, the effects of stress concentration and corrosion on fatigue resistance, the preparation of materials with high resistance to brittle failure, and various forms of fabricated materials and their mechanical properties, are discussed. (tr-auth)

51061 FIZIKO-KHIMIYA SPLAVOV I TUGOPLAVKIKH SOEDINENII S TORIEM I URANOM. (Physical Chemistry of Alloys and Refractory Compounds of Thorium and Uranium). Ivanov, O. S. (ed.). Moscow, Izdatel'stvo Nauka, 1968. 235p.

Phase diagrams and new data concerning the structure of Th and U alloys with rare metals, Zr, Nb, Mo, and Ti are described. The results of investigating the transformations and structures of U alloys in nonequilibrium states are reported. Information is given concerning the physical and mechanical properties and also the creep stability of U alloys at elevated temperatures. Descriptions are given of the structure, oxidation in air, and the mechanical properties of refractory compounds of Th and U with Al, Be, C, O, and Si, and of the physical-chemical interaction with alloys of these compounds, especially on UC and the uranium oxides, with refractory metals and their compounds. The high-temperature chemistry of UO_2 and UO_3 compounds with oxides of alkali-earth metals and the reactions of these orthouranates with refractory oxides of other metals are discussed. (tr-auth)

51062 EFFECT OF OXYGEN AND NITROGEN ON THE DUCTILITY OF WELDS IN NIOBIUM ALLOYS. Zhabina, V. A.; Ivanov, V. K.; Konstantinov, V. A.; Zdobnov, Yu. F. pp 269 of Metody Opredeleniya Gazov v Metallakh. Moscow, Izdatel'stvo Nauka. (In Russian).

An investigation to determine the effect of oxygen and nitrogen on ductility of niobium and niobium-alloy welds was conducted. Welds of these metals were prepared using specimens previously saturated with the gases. The content of oxygen or nitrogen in argon-shielded arc or electron-beam welded joints was determined by vacuum-melting or chemical analysis. The maximum allowable oxygen content in welds was established as 0.12% for niobium and 0.06% for niobium-molybdenum alloy. It was shown that nitrogen causes weld embrittlement at lower concentrations than oxygen. (JPRS)

Structure and Phase Studies

Refer also to abstracts 51009, 51031, and 51796.

51063 (COO-1431-7) EFFECT OF ANNEALING ON THE SUBSTRUCTURE OF COLD WORKED fcc METALS AND ALLOYS. Technical Progress Report No. 5, September 1, 1968-September 1, 1969. Mikkola, D. E.; Borich, D. J.; Sakai, M. (Michigan Technological Univ., Houghton. Dept. of Metallurgical Engineering). Contract AT(11-1)-1431. 25p. Dep. CFSTI.

Research on relations between the structures and properties of metals and alloys is summarized. The observed changes in substructures as shown by x-ray diffraction and transmission electron microscopy are analyzed in terms of physical properties. Materials studied during the report period include Cu-Ge solid solutions, and the intermetallic Cu_3Au, Ni_3Al, and Pt_3Co compounds. (J.R.D.)

51064 (GEMP-708) NATURE OF AGING OF Fe-Cr-Al-Y ALLOYS AT 450°C. Bartos, J. L. (General Electric Co., Cincinnati, Ohio. Nuclear Systems Programs). July 16, 1969. Contract AT(40-1)-2847. 12p. Dep. CFSTI.

When Fe-Cr-Al-Y alloys containing 15 wt percent chromium or more are aged at 450°C, a chromium-rich ferrite, denoted α', is precipitated. The presence of aluminum and yttrium changes the distribution of α' from the very fine, uniform precipitate found in binary iron-chromium alloys to a grain boundary phase in Fe-Cr-Al-Y alloys. The presence of α' has a deleterious effect on the slow bend ductility of these alloys. Aging for 1000 hours at 450°C raises the ductile-to-brittle transition temperature 75 to 100°C. The addition of molybdenum promotes α' precipitation, but the resulting α' overages after ~250 hours at 450°C. (auth)

51065 (ORNL-TM-2682) TEXTURES OF DRAWN AND PLANETARY SWAGED TUBES OF 0.2 PERCENT Ti TYPE-304L STAINLESS STEEL. Nilsson, T. M. (Oak Ridge National Lab., Tenn.). Oct. 1969. Contract W-7405-eng-26. 17p. Dep. CFSTI.

Development of texture in the austenitic phase during fabrication of Type 304L stainless steel tubing modified with 0.2% Ti is described. Planetary swaging and mandrel drawing at various reduction schedules were used. Textures developed during fabrication depended on working techniques and reduction schedules, even after small amounts of deformation. Annealing textures were, in general, randomized versions of the deformation textures. In drawing, the component [0 0 1]axial direction-[1 1 0] radial direction was found after both primarily ironing and primarily sinking reductions. The characteristic feature after planetary swaging was a large number of circumferential {1 1 1} planes. Analyses of the fabrication techniques and corresponding texture developments confirm that close-packed directions align parallel to the direction of maximum compression. (auth)

51066 MICRO-SPHERE PROBE OF THE CRYSTALLOGRAPHIC ORIENTATION OF HYDRIDES IN FINE-GRAINED ZIRCALOY TUBING. Kearns, J. J. (Bettis Atomic Power Lab., West Mifflin, Pa.). J. Nucl. Mater., 33: 114-18(Oct. 1969).

Data are presented to show that intergranular habit planes tilted higher than about 25° to the basal plane are not active in Zircaloy-4 samples whether they are stressed or unstressed, fine grained or coarse grained, slowly cooled or quenched. The overall hydride orientations are associated in Zircaloy-4 tubing specimens to gross crystallographic texture found in such samples. (J.R.D.)

51067 INTENSITY ANOMALIES IN THE X-RAY DIFFRACTION PATTERN OF Ni_3Nb AND THEIR RELATIONSHIP TO THOSE FOR MARTENSITE. Kaufman, A.; Hoffman, N. J.; Lipson, H. (Technion, Haifa, Israel). Scr. Met., 3: 715-20 (Oct. 1969).

Electron diffraction and electron microscopic data were analyzed to determine the structure of tetragonal Ni_3Nb. Intensity anomalies are examined and structural implications are discussed. Results of these investigations are compared with similar investigations on martensite. (J.R.D.)

51068 EFFECT OF MAGNETIC FIELD ON THE CRYSTAL STRUCTURE OF DYSPROSIUM. Finkel, V. A.; Belovol, V. S. (Physical-Technical Inst. of Low Temperatures, Kharkov). Zh. Eksp. Teor. Fiz., 57: 774-80(July 1969). (In Russian).

The effect of magnetic fields up to 16 kOe on the crystal structure of polycrystalline dysprosium in the paramagnetic (300°K), antiferromagnetic (145°K), and ferromagnetic (77°K) states is studied. It is shown that at 145°K and a field of ~10 kOe, an antiferromagnetism-ferromagnetism transition of the first kind occurs which is concurrent with lowering a symmetry of the crystal lattice from an hexagonal to a rhombic one. A certain type of dynamic texture is formed in the ferromagnetic state which is related to the tendency of the magnetic moments to become oriented at a minimal angle with respect to the field. (auth)

51069 TEMPERING TRANSFORMATIONS OF Cu-Al-Be AND Cu-Al-Be-Fe ALLOYS. Hori, Masaiti (Kanagawa Univ., Yokohama, Japan). Nippon Kinzoku Gakkaishi, 33: 878-82(Aug. 1969). (In Japanese).

Tempering transformations of Cu-Al-^{4}Be-Fe alloys were studied by means of specific heat measurements. It was found that the microstructures of quenched Cu-Al-Be alloys were β_1. Tempering processes of quenched Cu-Al-Be alloys were precipitations of α or γ_2 and $\beta_1 \rightarrow \beta$. But the abnormal phenomena took place at about 250°C in a hypo-eutectoid alloy. The microstructure of the quenched hypo-eutectoid Cu-Al-^{4}Be-Fe alloy was β' martensite. Tempering processes of the hypo-eutectoid Cu-Al-^{4}Be-Fe alloy showed abnormal phenomena at about 300°C, $\beta' \rightarrow \beta_1$, precipitations of α, $\beta_1 \rightarrow \alpha + \gamma_2 + \kappa$, $\beta_1 \rightarrow \beta$, $\beta \rightarrow \alpha + \gamma_2 + \kappa$ and $\alpha + \gamma_2 + \kappa \rightarrow \beta$. The microstructures of quenched hypereutectoid Cu-Al-^{4}Be-Fe alloys were β_1. Tempering processes of hyper-eutectoid Cu-Al-^{4}Be-Fe alloys were precipitations of γ_2, $\beta_1 \rightarrow \beta$, $\beta \rightarrow \alpha + \gamma_2 + \kappa$ and $\alpha + \gamma_2 + \kappa \rightarrow \beta$ in the lower Be alloy, but became $\beta_1 \rightarrow \beta$ after the precipitation of α in the higher Be alloy. (auth)

51070 STRUCTURE OF THORIUM ALLOYS WITH RHENIUM. Badaeva, T. A.; Dashevskaya, L. I. pp 212-18 of Diagrammy Sostoyaniya Metallicheskikh Sistem; Obzor Issledovaniy. Moscow, Izdatel'stvo Nauka, 1968. (In Russian).

The structure of thorium alloys containing rhenium was determined from data on x-ray phase analysis, microstructure, hardness, microhardness tests and melting temperature of cast and sintered specimens in hardened (after protracted holding) condition. Specimens of compacted thorium (99.6%), powdered thorium (99.5%) and powdered rhenium (99.8%) were used. A thorium-rhenium phase diagram was constructed. It is shown that the earlier compound $ThRe_2$ (of the $MgZn_2$-C_{14} with parameters a = 5.492 ± 0.003Å, c = 9.097 ± 0.007Å, c/a = 1.656) is formed from a peritectic reaction and is in eutectic equilibrium with thorium; the eutectic's composition satisfies 14.9 at. % of rhenium at 1400°C. The width of the homogeneity region of the $ThRe_2$ compound corresponds to the stoichiometric composition only. Thorium and rhenium form no noticeable regions of solid solutions. (JPRS)

51071 MECHANISM OF PRECIPITATION HARDENING IN Cu-Be ALLOYS. Henmi, Zenzo; Nagai, Takeshi (Fujitsu Labs., Ltd., Kawasaki, Japan). Trans. Jap. Inst. Metals, 10: 166-73 (May 1969).

Since the Cu-Be alloys have excellent age hardenability, many investigations have been carried out on their characteristics. The x-ray diffraction technique and electrical resistivity measurement were mainly used in earlier work, but recently the use of transmission electron microscopy has contributed greatly to clarification of the mechanisms of precipitation. Copper-Be alloys were aged for 2 hr at temperatures between 120 and 350°C and the mechanism of precipitation hardening was studied by hardness measurement, optical microscopy, and transmission electron microscopy. The results show that the aging sequence of the Cu-Be alloys is α phase → G. P.(I) zone → G. P.(II) zone → γ' phase → anomalous γ' phase in the grains and α phase → dilute α phase plus γ phase at the grain boundaries. The γ phase at the grain boundary in both Cu-2% Be and Cu-Be 25 alloys initially precipitates at the aging temperature of 250°C. Furthermore, the effect of Co on the precipitation hardening was studied by optical microscopy and x-ray microanalysis. (auth)

51072 MICROSTRUCTURE OF NICKEL-BASED SUPERALLOYS. Sabol, G. P.; Stickler, R. (Westinghouse Research Labs., Pittsburgh). Phys. Status Solidi, 35: 11-52(Sept. 1, 1969).

Ni-based superalloys are complex materials consisting of the γ matrix phase, γ' intermetallic phase, carbides, and several minor phases. The empirical development of superalloys has resulted in extremely complicated microstructures which are difficult to interpret. A review is made of the available recent literature on Ni-based superalloys, and the information on the microstructure is summarized. The prediction of t.c.p. phase formation by the PHACOMP method is discussed. (D.L.C.)

51073 INVESTIGATIONS OF INTERMETALLIC COMPOUNDS IN THE BINARY SYSTEMS Nb-Fe AND Ta-Co BY MEANS OF AN EMISSION ELECTRON MICROSCOPE. Wetzig, K. (Technische Univ., Dresden). Phys. Status Solidi, 34: K79-81(Aug. 1, 1969).

The equilibrium between the Laves-phase matrix ($NbFe_2$, $TaCo_2$) and the μ phase (NbFe and TaCo) was studied using a secondary electron emission microscope. The μ-phase precipitations were found to occur along pyramidal planes $\{10\bar{1}1\}$ of the matrix, and the atomic arrangements of the $\{10\bar{1}1\}$ planes of both lattices were measured. The volume concentrations of the μ phases in the two-phase areas were measured planimetrically; the results indicate that NbFe and TaCo form eutectics with $NbFe_2$ and $TaCo_2$, respectively. (D.L.C.)

51074 DEVELOPMENT OF THE SIGMA PHASE IN THE W-Re SYSTEM. Waldhauser, I. Hiradastechnika, 19: 215-20(1968). (In Hungarian).

By crystallographic analysis of the phases occurring in the W-Re system it was found that the difficulties encountered in working high-tungsten alloys are due to the tetragonal sigma-WRe phase, stable above 42 at. % Re, whose atomic arrangement impedes the development of slip planes. Analogously to the thoroughly investigated Fe-Cr system it is anticipated that even

small amounts of impurities will displace the phase boundaries. This is due to the sigma phase—as all intermetallic compounds of the W–Re system—being an electron compound which has hybrid electronic levels whose development is greatly affected by small quantities of impurities. (Hung. Tech. Abstr.)

Radiation Effects

Refer also to abstracts 50225, 51045, 51151, 51152, 51762, and 52356.

51075 (BNWL–1093) CALCULATED DAMAGE FUNCTIONS FOR DETERMINING IRRADIATION EFFECTIVENESS. Russcher, G. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Sept. 1969. Contract AT(45-1)-1830. 28p. Dep. CFSTI.

Data are provided for a technique which can be used by development engineers or designers to estimate the effectiveness of two or more reactor spectra in producing irradiation damage. Using this technique permits the calculation of the fluence in a reactor environment under design that is equivalent to the fluence which produced a measured materials property change in an irradiation environment. Included is a tabulated irradiation damage function that can be used to correlate irradiation spectra in terms of their relative effectiveness in producing damage. Two damage weighting functions have also been tabulated. (auth)

51076 (GEMP–706) NEUTRON DAMAGE IN MOLYBDENUM IRRADIATED AT HIGH TEMPERATURES. Rau, R. C.; Secco d'Aragona, F.; Ladd, R. L. (General Electric Co., Cincinnati, Ohio. Nuclear Systems Programs). Sept. 1969. Contract AT-(40-1)-2847. 20p. Dep. CFSTI.

Transmission electron microscopy has been used to characterize the microstructure of polycrystalline molybdenum irradiated at elevated temperatures (>0.3 T_m). Irradiation at 700°C produced dislocation loops within the grains and denuded zones along grain boundaries, while irradiation at 1000°C resulted in generally loop-free grains which occasionally contain bands of loops and dislocation debris parallel to grain boundaries. Diffraction contrast analyses showed that most of the loops are interstitial edge type, having a/2⟨111⟩ Burgers vectors, but that a few a⟨100⟩ loops were also present. Irradiation at these temperatures also produced small voids which were interpreted as representing aggregates of radioinduced vacancies. (auth)

51077 (JPRS–48331, pp 495–511) EFFECT OF RADIATION ON THE PROPERTIES OF STRUCTURAL MATERIALS. Ibragimov, Sh. Sh.; Bykov, V. N.; Vorob'ev, A. N.; Voronin, I. M.; Veremeev, A. M. Translated from pp 439–56 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 2, Obninsk, 1967.

Results are presented on investigations of the effects of neutrons on austenitic steels. Types 1 Cr 18 Ni 0 Ti, 1 Cr 18 Ni 8 Mo 2, 1 Cr 16 Ni 15 Mo 3 Nb, Cr 16 Ni 36 Mo Nb Ti A 1B, and 12% Cr ferrite were investigated. (J.R.D.)

51078 (JPRS–48331, pp 553–75) EFFECT OF REACTOR RADIATION ON STRUCTURE AND PROPERTIES OF STAINLESS STEELS. Balashov, V. D.; Votinov, S. N.; Grinchuk, P. P.; Ostrovskii, Z. E.; Prokhorov, V. I.; Shamardin, V. K.; Agapova, N. P.; Krasina, T. A. Translated from pp 492–509 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 2, Obninsk, 1967.

Results of investigations of austenitic stainless steel for use in high temperature reactors are presented. It was found that all materials studied were subject to plasticity reduction but the magnitude of this reduction varies with material composition and treatment. Results are presented in tables, diagrams, and photographs. (J.R.D.)

51079 (JUL–581-FN) DETERMINATION OF THE DISPLACEMENT FUNCTION IN Al AND Cu FROM THE MEASUREMENT OF THE ACTIVATION AT LOW TEMPERATURE ELECTRON IRRADIATION. Wurm, Joerg (Kernforschungsanlage, Juelich (West Germany). Institut fuer Festkoerper- und Neutronenphysik). Mar. 1969. 94p. (In German). Dep. CFSTI (U. S. Sales Only).

The damage rate in Al, Au, and Cu was experimentally determined for electron energies from 1.0 to 3.3 MeV at an irradiation temperature of 8°K. The displacement function was derived from these experimental methods. The displacement function P(E)n(E) was separated into P(E) and n(E) in the case of Al. The experimentally determined damage rates were affected by perturbation effects such as scattering and energy loss of the irradiation electrons in the production of Frenkel pairs and perturbation effects in the determination of Frenkel pair concentration using electrical resistances. These effects are compiled and their contributions are estimated. The uncertainties in the experimental determination of $E_{d,min}$ were evaluated. (J.S.R.)

51080 (ORO–3912-1) COMPUTER EXPERIMENT STUDIES ON MECHANISMS FOR IRRADIATION INDUCED DEFECT PRODUCTION AND ANNEALING PROCESSES. Progress Report for Period Ending August 31, 1969. Beeler, J. R. Jr. (North Carolina State Univ., Raleigh). Sept. 1969. Contract AT(40-1)-3912. 41p. Dep. CFSTI.

Computer experiments were performed on point defect behavior in three model metals designated as α-iron, γ-iron and nickel which were given properties similar to those of their real counterparts. Computation of vacancy migration energy matrix values was completed for vacancy migration near (110), (001), (112), and (111) free surfaces in α-iron. Simulation studies on the transition from small vacancy cluster configurations to faceted void configurations in pure α-iron were initiated. Configuration energies were computed for vacancy defect-carbon atom complexes and interstitial-carbon atom complexes in α-iron, γ-iron, and nickel. These calculations indicated that the most stable complex formed by vacancies and carbon is the divacancy-carbon atom complex in both α-iron and nickel. The binding energies for this complex were 0.62 and 0.80 eV in α-iron and nickel, respectively. Vacancy-carbon complexes in γ-iron were not bound. The second most stable complex was the monovacancy-carbon atom complex with binding energies of 0.42 and 0.21 eV in α-iron and nickel, respectively. In the case of interstitials, the most stable complex was composed of a single carbon atom and an interstitial in all three model metals. The respective binding energies in α iron, γ-iron, and nickel were 0.56, 0.36, and 0.46 eV. (auth)

51081 (WANL–TME–1943) CRYOGENIC MECHANICAL PROPERTIES OF IRRADIATED ALLOYS. Coombe, J. R.; Shogan, R. P. (Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.). Aug. 1969. 18p. Dep. CFSTI.

Development of the Nuclear Engine for Rocket Vehicle Application (NERVA) requires that the combined effects of nuclear radiation, temperature, and stress be considered. The NERVA reactor design requirements for material in this application of nuclear power to propulsion for extra terrestrial missions include temperatures from 40 to 5000°R in combination with high levels of nuclear radiation. The literature with rare exceptions does not include information on NERVA-type materials at the neutron fluences, nuclear heat generation rates, and temperature environment inherent in the NERVA design. Consequently, experimental programs have been conducted to evaluate materials and generate design data. The materials tested were hot pressed block beryllium, titanium–5% aluminum–2.5% tin ELI (A110AT), and an aluminum alloy 2219. These materials were irradiated at liquid nitrogen temperatures (140°R) and tensile tested without any intervening warm-up. Some of the liquid nitrogen irradiated and tested material data as well as room temperature data are presented. The effects of temperature on radiation characteristics and subsequent material properties after cryogenic temperature irradiation are discussed. The properties investigated have included ultimate tensile strength, 0.2% offset tensile and compressive yield strength, percent elongation, and fracture toughness. (auth)

51082 (WARD–3791-39) OXIDE FUEL ELEMENT DEVELOPMENT. Quarterly Progress Report for the Period Ending June 30, 1969. (Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.). Aug. 1969. Contract AT(30-1)-3791. 45p. Dep. CFSTI.

Work Performed under United States–Euratom Fast Reactor Exchange Program.

Activities in parallel analytical and experimental studies on mixed oxide fuel pins are reported. Analysis of clad swelling data for solution treated Type 304 Stainless Steel continued. The range of applicability was extended to temperatures greater than 550°C. The OLYMPUS IB code was selected as the model to be currently used for design purposes. This version can use either the Westinghouse–PNL agreed clad swelling equation or the Westinghouse F-2 equation. Improvements in the code are now in progress. The development of a fuel lifetime code was continued with emphasis on evaluating the mechanical models in CYGRO. Literature reviews and data analyses were initiated on a study of the effects of irradiation on the creep strength of stainless steels with particular emphasis on Type 316. Thermal and nuclear design of the two 19-capsule subassemblies was begun. Approval-in-principle of this program has been received from the AEC. It is desired to obtain the highest cladding temperatures possible in this experiment using a standard assembly. A formal request has been made to ANL for permission to slightly exceed the operating criteria of EBR-II, 1200°F, maximum capsule surface temperature and 1000°F, maximum coolant outlet temperature. Work continued on the de-

sign of the 37-pin subassembly. Procurement specifications for stainless steel materials were prepared or adapted from existing specifications and requests for quotes were issued. The response from prospective manufacturers was very limited principally because of the close dimensional tolerance requirements and the small quantities involved. Fabrication development materials were procured and welding trials were conducted. Work was begun on the 93% enriched fuel. All pellets were fabricated at 93% enrichment and of nominal 89 and 91% theoretical density. Fabrication of UO_2 insulator pellets was initiated. Twelve of the fourteen glove boxes and the transfer tunnel have been delivered and installed. Ten of the glove boxes have been completely assembled and leak tested and have met the leak testing requirements. (auth)

51083 NEUTRON IRRADIATION SOFTENING OF AGEING AUSTENITIC STEEL. Nikolaev, V. A.; Razov, I. A. At. Energ. (USSR), 27: 223(Sept. 1969). (In Russian).

Softening and aging of Ch18N22V2T12 austenitic steel were studied at 710°C following 10 hr exposure to neutron irradiation at integral doses of 4×10^{19} and 3.4×10^{20} n/cm^2 (E > 1 MeV) at 100, 250, 300, and 500°C. The specimens were tested for ductility at room temperature. Tests were made with five specimens 1 to 3 mm in diameter; results are tabulated. (R.V.J.)

51084 CAVITIES IN IRRADIATED TYPE 304 STAINLESS STEEL. Robbins, R. E. (Battelle Memorial Inst., Richland, Wash.). Contract AT(45-1)-1830. J. Nucl. Mater., 33: 101-2 (Oct. 1969).

Results of analyses of irradiated stainless steel for gases are presented which show that the quantity of He present is more by a factor of 20 than is accounted for by neutron–alpha reactions with the alloy constituents. It appears that neutron–alpha reaction cross section uncertainties are sources of error in calculating the radioinduced He. (J.R.D.)

51085 SOME OBSERVATIONS OF DISLOCATION CHANNELLING IN IRRADIATED IRON. Smidt, F. A. Jr.; Mastel, B. (Battelle-Northwest, Richland, Wash.). Contract AT(45-1)-1830. Phil. Mag., 20: 651-(Sept. 1969).

Dislocation channelling in iron irradiated to a fast fluence of 8×10^{19} n/cm^2 (E > 1 MeV) was found to be visible by virtue of dislocation arrays densely packed on slip planes. Such highly localized deformation in irradiated iron was found to be in marked contrast to the dense tangles and cell walls which develop in unirradiated iron deformed to a comparable strain. Analysis of the slip band geometry showed the active systems in the irradiated iron to be consistent with slip on {110} and {112} planes in a ⟨111⟩ direction. (auth) (UK)

51086 ANNEALING OF RADIATION DAMAGE IN TUNGSTEN INVESTIGATED BY FIELD-ION MICROSCOPY. Bowkett, K. M.; Ralph, B. (Univ. of Cambridge, Eng.). Proc. Roy. Soc. (London), Ser. A, 312: 51-63(Aug. 26, 1969).

Annealed tungsten wire was reactor-irradiated to a dose of 10^{17} n.v.t. (>1 MeV), and specimens for field-ion microscopy prepared from the wire. Vacancies could be identified in certain regions of the field-ion microscope image, and the size and shape of small clusters of vacancies could be found by careful field-evaporation. Using the field evaporation technique the clustering of vacancies was followed in specimens that were unirradiated, irradiated, and given certain post-irradiation heat treatments. The only interstitial defects seen arose from impurities. Specimens examined after being annealed in stage III (~400°C) showed fewer single vacancies, and there was a simultaneous increase in the number of small vacancy clusters. It is concluded that stage III annealing in tungsten may be associated with the migration of single vacancies to small clusters, rather than the migration of an interstitial defect. (auth)(UK)

51087 AUTOIONIC-MICROSCOPIC STUDY OF DEFECTS IN THE CRYSTAL STRUCTURE OF TUNGSTEN IRRADIATED WITH NEUTRONS. Kirienko, V. I.; Potapov, L. P. (Central Scientific Research Inst., Moscow). Dokl. Akad. Nauk SSSR, 186: 1309-11(1969). (In Russian).

In deformed metals irradiated with neutrons, a partial relaxation of internal stresses takes place with a low-temperature anneal. The behavior of the defects (internodal atoms and vacancies) can be observed directly at the atomic level with the use of an autoionic microscope. Drawn tungsten wire 0.1 mm in diameter was irradiated with 15 MeV neutrons at a flux of 10^{18} neutrons/cm^2. The irradiated samples were subjected to a series of equal-time annealings at 100 to 350°C. An analysis of the change in width of interference lines, carried out photometrically on Debyegrams showed a maximum relaxation of internal stresses at 200 to 300°C. Observation on the atomic surface structure was carried out microscopically on four neutron-irradiated samples. The movement of internodal atoms was observed on the photographs at 200 to 250°C in the form of points having a high brightness. Occasional vacancies were seen. These bright points were not observed on the unirradiated samples. Evidence for the observation of a crowd-ion was obtained in the form of a chain of atoms bent at 150°C. (TTT)

51088 MEASUREMENT OF STORED-ENERGY RELEASE AND SPECIFIC HEAT OF NEUTRON-IRRADIATED METALS BY MEANS OF A DIFFERENTIAL HEAT FLUX CALORIMETER. Rau, F. (Institut fuer Festkoerper- und Neutronenphysik, Juelich, Ger.); Wenzl, H. Z. Angew. Phys., 27: 346-54(Aug. 27, 1969). (In German).

A differential heat flux calorimeter is described for measuring small heats of reaction and the specific heat of massive samples after fast neutron irradiation at low temperatures (4.6°K). The calorimeter can be used at constant or linearly increasing temperature in the range from 4°K to 300°K. One measures directly the heat flux through the surface of the sample. This type of calorimeter is especially suited to analyze reaction kinetics of stored energy release in crystals after irradiation. The sensitivity ranges from 1.5×10^{-5} W for T ≈ 270°K to 4×10^{-4} W for T ≈ 4°K. For a heat release of 2 mW, the total experimental error is ≦9% at T ≧ 30°K and ≦18% at T ≦ 20°K. Measurements of stored energy release in niobium and copper after 4.6°K neutron irradiation are given as examples. (auth)

Ceramics and Cermets

Refer also to abstracts 50977 and 50978.

51089 (NUMEC–3524-50) DEVELOPMENT AND TESTING OF PuO_2–UO_2 FAST REACTOR FUELS. 12th Quarterly Report, January–March 1968. (Nuclear Materials and Equipment Corp., Leechburg, Pa. Plutonium Lab.). May 1968. Contract AT-(30-1)-3524. 31p. Dep. CFSTI.

The three subassemblies containing 41 20 wt % PuO_2–UO_2 fuel rods are in EBR-II Run 27D. The first eleven rods to be removed for post-irradiation examination (C Series) had accumulated an exposure of 5192 MWd. These rods are scheduled for an accumulated burnup of 35,000 to 38,000 MWd/te burnup (7500 MWd). Work is continuing on the fabrication of the NUMEC designed profilometer. The system is entirely automatic for use with both irradiated and nonirradiated fuel rods. An electronic readout capability is provided for with the integrated system accuracy good to 0.0002". The screening runs evaluating hammermilling (Fitzmill) as an alternative to ballmilling for mechanically blending PuO_2 with UO_2 have been completed. A parallel study of dry ballmilling for comparison has also been completed. Both oxalate produced PuO_2 and oxidized metal PuO_2 were used in the study. The oxalate PuO_2 ballmilled with Eldorado UO_2 produced a homogeneous mixture after 4 to 8 hours of ballmilling using steel balls. With tungsten carbide balls, the milling time for an equivalent homogeneity was 2 hours. Impurity pickup during ballmilling was minimal. The metal oxidized PuO_2 ballmilled with the UO_2 did not result in a homogeneous sintered product after extended milling periods (up to 60 hours). The initial PuO_2 powder characteristics have a determining effect on the product homogeneity for the mechanical blending of PuO_2 with UO_2. A pre-treatment step for oxidized metal PuO_2 to improve the particle characteristics will be required prior to milling with UO_2 if adequate product homogeneity is to result. The Fitzmilling did not produce a homogeneous product after 3 passes through the mill using the smallest screen size opening. However, the larger agglomerates of both UO_2 and PuO_2 were broken up and a uniform dispersion of PuO_2 in UO_2 was the result. Autoradiographs of all sintered products are shown. All samples containing PuO_2 and 18 wt % PuO_2–UO_2 microspheres (5 to 350 μ diameter) have been fabricated and autoradiographed using metallographic plate film. The significant autoradiographs are shown. Contact pressure between the film and sample was an important factor in film sharpness. A minimum pressure of 15 psi was necessary for good detail. The exposure time for sharpness was not critical within a given range related to the film type. The dynamic factors affecting the results obtained in the thermogravimetric analysis have been evaluated. A method for deriving a "correction factor" for a given set of operating conditions has been established. The effects of the metallic impurities Cr, Fe, Mo, Ni, and Si at levels from 250 to 5000 ppM on density and chemistry (residuals after sintering) have been determined. The results are shown in tabulated form. The results for chloride and fluoride ions at 100, 500 and 1000 ppM and sulfate and phosphate ions at 500, 2000 and 5000 ppM are also tabulated. (auth)

Corrosion and Erosion

Refer also to abstracts 50038 and 50994.

51090 COMPATIBILITY STUDIES CONCERNING THE USE OF A LIQUID METAL JOINT IN AN URANIUM–CARBIDE/SINTERED ALUMINIUM (SAP) FUEL ELEMENT. Lensi, P. L.; Schleicher, H. W. (Euratom, Ispra, Italy). J. Nucl. Mater., 33: 77-89(Oct, 1969).

The feasibility of liquid joints between fuel and can in the case of UC/SAP fuel elements was examined by compatibility tests using liquid metals. On the basis of these tests Na, NaK, and Bi have to be excluded because of a too rapid reaction with SAP, but lead seems promising, especially when the SAP has been anodically oxidized in a suitable manner. The tests are described and conclusions as to further studies are drawn. (auth)

51091 SURFACE PHENOMENA DURING OXIDATION OF U_3Si. Kimmel, G.; Niedzwiedz, S. (Israel Inst. of Tech., Haifa). J. Nucl. Mater., 33: 119-23(Oct. 1969).

X-ray diffraction spectral data are used as the basis of a model of mechanisms associated with the high temperature oxidation resistance of U_3Si. The resistance is attributed to formation of a protective layer of U_3Si_2 which passivates the bulk U_3Si material. (J.R.D.)

Preparation and Fabrication

Refer also to abstracts 49992, 50002, 50006, 50990, 51028, and 52058.

51092 (AECL–3373) STUDY OF THE OPTIMIZED CONDITIONS FOR FABRICATION OF URANIUM DIOXIDE PELLETS BY PRESSING. Ledac, A. (Commissariat a l'Energie Atomique, Paris (France)). Translated by L. C. Berthiaume (Atomic Energy of Canada, Ltd., Ontario), from report CEA-DM–1741. 19p. Dep. CFSTI (U. S. Sales Only).

Circumferential cracking at and near the end faces (i.e., end capping) was encountered in fabricated UO_2 pellets. To determine the cause of these faults the following parameters were investigated: the clearance between plunger and die during pressing; the pressing pressure; and the type of UO_2 powder used–prepressed granulated powder vs as-received powder. The faults were attributed to excessive clearance between the plunger and die and worsened as the pressing pressure increased, independently of the type of powder used. Satisfactory pellets were produced at a plunger and die diameter clearance of 0.03 mm. (auth)

51093 (LA–4164) FABRICATION OF BORON CARBIDE RINGS AND DISKS. Sheinberg, H.; Herrera, T.; Kostacopoulos, J. (Los Alamos Scientific Lab., N. Mex.). Apr. 25, 1969. Contract W-7405-eng-36. 11p. Dep. CFSTI.

Boron carbide components, varying in size from 3.2-in.-dia by 3.0-in.-long cylinders to 7.7-in.-OD by 6.2-in.-ID by 2.4-in.-long rings, were hot pressed to a minimum density of 95% of theoretical for use as neutron absorbers in a physics experiment. Powder characteristics, die design, pressing conditions, and the dimensional and density variations of the hot-pressed components are discussed. (auth)

51094 (NMAB–257) USAGE PATTERNS FOR TELLURIUM. Report of the Panel on Tellurium of the Committee on Technical Aspects of Critical and Strategic Materials. (National Materials Advisory Board (NRC), Washington, D. C.). Aug. 1969. 25p.

Since tellurium is recovered principally as a byproduct from copper and lead refining, its supply depends greatly on copper and lead production. The United States has been the leading producer and consumer of tellurium in recent years. Production of tellurium by North American refiners is typically in the range of 200,000 to 250,000 pounds per year and consumption in the United States is also about the same level. Tellurium is used by the rubber, metallurgical, chemical, and electronics industries. It is a secondary vulcanizing agent in the processing of both natural and GR-S synthetic rubber, a carbide stabilizing agent in the production of white cast iron, a machinability additive for carbon steel and copper, and an additive to lead to improve corrosion resistance. Tellurium is also used in thermoelectric and in semiconductor devices. Tellurium consumption should grow moderately for the next several years. As the United States produces a large portion of its consumption, and procures most of the rest from Canada, no supply problems are anticipated. (auth)

51095 (RISO–197) PILOT PLANT FOR MANUFACTURE OF UO_2 PELLETS. Soerensen, O. Toft (Danish Atomic Energy Commission, Risoe, Research Establishment). Mar. 1969. 32p. Dep. CFSTI (U. S. Sales Only).

A pilot plant for the manufacture of natural as well as enriched UO_2 powder and pellets was developed. The methods and the equipment developed as well as the results obtained during a typical manufacturing run of UO_2 pellets for an irradiation experiment are described. (auth) (Denmark)

51096 SOME PROPERTIES OF URANIUM MONOCARBIDE WITH SMALL ADDITIONS OF ZIRCONIUM. Bocker, S.; Boucher, R. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses, France). J. Nucl. Mater., 33: 30-9(Oct, 1969). (In French).

The preparation by casting of uranium carbide samples for research purposes presents several advantages, such as high purity, high density, and ease of fabrication. However the addition of small quantities of zirconium (1 to 5 at. %) to the monocarbide of uranium, makes casting of samples in an arc-furnace very difficult. These difficulties have been surmounted by using specially designed graphite molds. (auth)

51097 SIMULTANEOUS CHEMICAL VAPOUR DEPOSITION OF CARBON AND URANIUM. Marinkovic, S.; Suznjevic, C.; Dezarov, I. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). J. Nucl. Mater., 33: 103-6(Oct. 1969).

A method is described for codeposition of C and U on graphite from mixed $CH_4 + UF_6$. The UF_6 gas from thermostated containers passes to a pyrolytic furnace together with CH_4. The codeposition is effected on the inner surface of an induction-heated graphite tube at 1420 to 1640°C and 50 to 150 torr. Data are included on the properties of the pyrocarbon. The presence of uranium appears to promote graphitization of the pyrocarbon. (J.R.D.)

51098 ELECTROLYTIC INTERNAL GRINDING SAVES TIME, WHEEL COST ON CARBIDES. Benz, Heinz H. Abrasive Eng., 15: 41-2(Mar. 1969).

Grinding time may be reduced 60% when holes in tungsten carbide dies are ground on an electrolytic internal grinder. Other advantages are that the diamond wheels last longer and surface cracks in workpieces are eliminated because electrolytic grinding generates little heat. Radial pressure against the wheel is light, extending spindle life. The electrolyte used is sodium chlorate. (Metals Abstr.)

51099 METHOD FOR APPLYING LOW DENSITY CARBON COATINGS. Beutler, H.; Payne, M. C. (to United States Atomic Energy Commission). U. S. Patent 3,472,677. Oct. 14, 1969.

An improved method for depositing highly porous carbon coating having a density of about 0.6 to 1.0 grams per cubic centimeter on reactor fuel particles by thermal decomposition of acetylene gas at elevated temperatures is provided comprising fluidizing the fuel particle with undiluted acetylene gas at a gas pressure of substantially 760 torr and at a temperature within the range of 1100 to 1250°C. (AEC)

51100 ASPECTS OF SINTERING SOME URANIUM OXIDES WITH HIGH NON-STOICHIOMETRY. Denetrescu, S. Rev. Chim. (Bucharest), 20: 443-4(July 1969). (In Rumanian).

The effects of the U/O ratio on the sintering of $UO_{2.40}$ and the mixture $UO_2 + U_3O_8$ at 1350°C in hydrogen or argon were studied. (R.V.J.)

51101 PHYSICOCHEMICAL AND DIELECTRIC PROPERTIES OF GLASSES AND GLASS CRYSTALLINE MATERIALS IN NIOBATE SYSTEMS. Freydenfel'd, E. Zh.; Milberg, Z. P.; Riyekstin, T. P. (Inst. of Inorganic Chemistry, Riga). pp 183-7 of Izdatel'stvo Zinatne, 1967. (In Russian).

A study in glass compositions showed the possibility of obtaining transparent glasses at certain concentrations of components with the use of SiO_2 and Nb_2O_5 as the vitrification agent, as well by replacing a certain amount of either SiO_2 or Nb_2O_5 with either SnO_2 or Ta_2O_5, respectively. The glasses obtained may be crystallized by holding them for a certain time at 730°C. The amount of the crystalline phase grows with the growth of holding time at this temperature. At room temperature, the crystalline phase is ferroelectric with the Curie point of the order of 360°C. (JPRS)

51102 FUEL ELEMENTS FOR FAST REACTORS. Atomwirt., Atomtech., 14: 319-20(June 1969). (In German).

Extensive studies were made on the fuel element composition and breeder mantle elements for the Masurca and Rapsodie research reactors and the Phenix prototype. The fabrication of these elements was automated to a great extent. A brief description is given of the composition of the fuel elements and breeder elements. (tr-auth)

51103 PREPARATION AND PROPERTIES OF BeO THIN FILMS. Nagai, Haruo (Nippon Telegraph and Telephone Public Corp., Tokyo). Jap. J. Appl. Phys., 8: 1221-8(Oct. 1969).

BeO thin films have been prepared by hydrolysis of $BeCl_2$ in the temperature range 690°C to 1200°C, and studied by electron diffraction. The films are found to be apt to take a fiber structure with the c-axis oriented vertically to the substrate. It has been observed that one of these films was epitaxially grown on single crystal Si substrate. The infrared spectra of oriented films have been studied in the range 400 cm^{-1} to 4000 cm^{-1}. Comparing these spectra with that of BeO powder, a view on the assignment for BeO infrared spectra is given. (auth)

51104 METHOD FOR PRODUCING POWDER-PACKED FUEL ELEMENTS. Takeda, Seiji (to Hitachi Ltd.). Japanese Patent 1969-9558. May 2, 1969. Filed June 28, 1965.

A method is proposed for increasing the packing density of small diameter fuel tubes to a degree greater than that of ordinary clad tube elements. A packing density of greater than 88% is obtained regardless of the diameter of the clad tube. Fuel elements produced this way have high heat output, improved nuclear properties, and smaller volumes of fission gases, preventing high internal pressures. The method is applicable to fuel powders, such as oxides, nitrides, carbides, and silicides of U, Th, and Pu. In packing tubes less than 10 mm ID with different sizes of fuel powder particles to obtain a high powder density, a mixture consisting of large particles, medium particles, and small particles is used. The friction among the powder particles, and between the powder particles and the tube wall are in this way reduced, to produce powder fuel elements of high density. (NSA of Japan)

51105 A PROCESS FOR THE PRODUCTION OF SINTERABLE URANIUM DIOXIDE. (to Nuklear-Chemie und-Metallurgie (GmbH). British Patent 1,167,784. Oct. 22, 1969. Priority date Apr. 2, 1966, Germany.

A process for production of UO_2 is described in which gaseous UF_6 is reacted with gaseous NH_3 and the product of this reaction is converted to UO_2 by pyrohydrolysis. (J.R.D.)

51106 BONDING OF COMPRESSED GRAPHITE STRUCTURES. Sanders, James A. Jr. (to The Dow Chemical Co.). U. S. Patent 3,475,244. Oct. 28, 1969. Filed Apr. 4, 1966.

A process for pressure-bonding compressed vermicular graphite structures to other relatively dense structures or to other compressed vermicular graphite structures is described. The compressed vermicular graphite surface to be bonded is first treated with a re-expanding agent which penetrates the surface, then is heated to a temperature sufficient to produce re-expansion of the graphite surface, and finally is pressed tightly against the structure to which the graphite is to be pressure-bonded. (Offic. Gaz.)

51107 METHODS OF FORMING AN OXIDE LAYER ON A ZIRCONIUM ALLOY. (to Atomic Energy of Canada Ltd.). British Patent 1,168,371. Oct. 22, 1969. Priority date Sept. 19, 1966, Canada.

A method of forming a surface oxide layer on Zr alloys such as Zircaloy is described. The surface is roughened and exposed to air at 600 to 650°C for 24 to 96 hr. The oxide layer is tightly adherent, uniform, and can be 0.0005 to 0.008 in. in thickness. (J.R.D.)

51108 IMPROVEMENTS IN AND RELATING TO COATINGS FOR COLUMBIUM ALLOYS. (to United Aircraft Corp.). British Patent 1,163,615. Sept 10, 1969. Priority date Oct. 23, 1965, United States.

Oxidation preventing coatings for Nb and Nb alloys are described. The coatings contain at least 35% by weight Nb as niobium silicide. The alloys also contain Ti and optionally V and/or Cr. The Ti and (when present V and Cr) are present in an amount of 7 to 35% by weight. Coated articles using these materials have good resistance to oxidation. (J.R.D.)

Properties Evaluations

Refer also to abstracts 51044, 51056, 51143, 51414, 51802, 51803, 52374, and 52489.

51109 (ALO-(2510)-6) SILICON GERMANIUM THERMOELECTRIC MATERIALS AND MODULE DEVELOPMENT PROGRAM. Quarterly Report No. 6, April 1-June 30, 1969. (Radio Corp. of America, Harrison, N. J. [Special Electronic Components Div.]). Contract AT(29-2)-2510. 83p. Dep. CFSTI.

Development of the capability to coat graphite hot shoes with Si and the establishment of an initial capability to bond these shoes to SiGe are reported. It was demonstrated on one couple that the nominal 80 at.% SiGe gives an improved performance over the 63.5 at.% SiGe material. Operation of the same couple with the hot shoe temperature increased to 1250°C for 48 hours without any damage to the couple or deterioration in performance is reported. The objective parameters for two foil-insulated converters to be fabricated during FY70 was established; both converters will be optimized for both specific power and efficiency. The converters are intended to simulate operational devices as closely as possible. The design parametric of the first converter (C-4) was performed. The device efficiency of the 5-watt foil insulated converter was improved to 6.6% at 1000°C hot shoe temperature by placement of additional microquartz insulation in the small gap between the foil and the couples. The completion of over 8300 hours of operation of the Reference Design Converter and of over 7400 hours for the 5-watt Min-K 2020 insulated converter at approximately 1000°C hot shoe temperatures without significant change in power output or efficiency. Satisfactory operation (3100 hours) of a 4-couple module at approximately 1150°C hot shoe temperature is continuing. A summary of the parametric analyses of a SiGe hot stage cascaded to a PbTe Isotec cold stage, with a compilation of all the significant cascade parametric curves is included. (J.R.D.)

51110 (Y-1689) EFFECT OF LOW AND INTERMEDIATE STRAIN RATES ON THE COMPRESSIVE STRENGTH OF CELLULAR CARBON AT THREE DENSITY LEVELS. Oakes, R. E. Jr. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). Oct. 2, 1969. Contract W-7405-eng-26. 12p. Dep. CFSTI.

Cellular carbon in the unbonded state at nominal density levels of 0.05, 0.10, and 0.22 g/cc has been tested in compression, both parallel and normal to the direction of cell rise, at strain rates between 1.7×10^{-5} and 50 in./in.-sec. Effects of the strain rate on the ultimate compressive strengths have been determined. (auth)

51111 PREPARATION AND PROPERTIES OF ZIRCONIUM REFRACTORIES STABILIZED BY CERIUM DIOXIDE. Andreeva, A. B.; Leonov, A. I.; Keler, E. K. Ogneupory, No. 3, 37-44(Mar. 1969). (In Russian).

The reaction of ZrO_2 with varying amounts of CeO_2 was studied. Dilatometric, roentgenographic, and microscopic studies of the specimens obtained were made. The influence of the crystal structure of ZrO_2 on its polymorphic transformation and the increase in thermal stability of Zr-Ce refractory materials were analyzed. (tr-auth)

51112 ELECTRIC CONDUCTIVITY OF HOT-PRESSED ZIRCONIUM DIOXIDES. Degtyareva, E. V.; Alekseenko, L. S. Ogneupory, No. 3, 44-6(Mar. 1969). (In Russian).

The electric conductivity and stability of hot-pressed specimens of ZrO_2 were investigated. The electric resistance of the hot-pressed specimens was one order below that of sintered ZrO_2 of the same composition in the temperature range of 1300 to 2000°C. (tr-auth)

51113 ROOM TEMPERATURE FRACTURE OF ZIRCONIUM/HYDROGEN ALLOYS. Beevers, C. J.; Edmonds, D. V. (Univ. of Birmingham, Eng.). J. Nucl. Mater., 33: 107-13(Oct. 1969).

The role of hydride precipitates in the reduced impact strength of Zr at 20°C is described. At a hydrogen content of about 100 ppM hydride platelets deform macroscopically, although those oriented approximately parallel to the tensile axis often fracture. Thin parallel-sided matrix twins can cause hydride fracture, although this twinning mode is infrequent at 20°C and makes a negligible contribution towards embrittlement. Increasing the thickness of ZrH platelets by increasing hydrogen content to 260 ppM and above, reduces the ability of those platelet precipitates oriented approximately normal to the tensile axis to follow matrix deformation and leads to their fracture, and consequently to more severe embrittlement. (J.R.D.)

51114 RELAXATION PEAKS IN SINTERED UO_2-U_4O_9 PELLETS. Domoto, K.; Igata, N.; Kobayashi, S. (Power Reactor and Nuclear Fuel Development Corp., Tokai). J. Nucl. Mater., 33: 90-8(Oct. 1969).

The internal friction of sintered pellets of composition from $UO_{2.00}$ to $UO_{2.25}$, including the phases UO_{2+x} and U_4O_{9-y}, was measured by an ultrasonic attenuation method over the temperature range from −196 to +200°C. Internal friction maxima were observed at about −145 and +85°C, when measured at 5 Mc/sec. The higher temperature maximum can be analyzed into two peaks, one of which increased with the amount of the U_4O_{9-y} phase. This one is associated with the phase transition in U_4O_{9-y} and the other is attributed to a reorientation of interstitial oxygen atoms in UO_{2+x}.

The height of the peak below room temperature was proportional to the amount of $U_4O_{9-\gamma}$ phase. This peak may be due to electronic relaxation in the $U_4O_{9-\gamma}$ phase, induced by dislocation motion. (auth)

51115 ELASTIC CONSTANTS OF THE CARBIDES, NITRIDES, AND OXIDES OF URANIUM AND PLUTONIUM. Padel, A.; De Novion, Ch. (SECPER, Fontenay-aux-Roses, France). J. Nucl. Mater., 33: 40-51(Oct. 1969). (In French).

The velocity of sound and the elastic constants of polycrystalline UC, UN, and UO_2 at room temperature as function of porosity were measured. Also, the Young's modulus and the internal friction (at the fundamental longitudinal resonance frequency) of UC, UN, UO_2, $(U_{0.82}Pu_{0.18})N$, and $(U_{0.88}Pu_{0.12})O_{2\pm x}$ at 25 to 1300°C were measured by resonance techniques. (auth)

51116 DIFFUSION OF HYDROGEN IN BORON–PALLADIUM ALLOYS AT LOW HYDROGEN CONTENTS. Allard, K. D. (Univ. of Vermont, Burlington); Flanagan, Ted B.; Wicke, E. Z. Phys. Chem. (Frankfurt), 66: 329-32(Aug. 1969).

A Faradaic perturbation was applied to a thin, rectangular specimen that initially had a uniform hydrogen concentration profile. The perturbed profile subsequently relaxed to a new, uniform profile; the time-course of the relaxation was followed by changes of electrode potential. The diffusion equation was solved using this profile. Data support the view that hydrogen atoms diffuse via tetrahedral holes in the palladium lattice. (M.C.G.)

51117 THERMODYNAMICS OF RARE-EARTH–CARBON SYSTEMS. III. THE ERBIUM–CARBON SYSTEM. Balducci, G.; De Maria, G.; Guido, M. (Univ., Rome). J. Chem. Phys., 51: 2876-9(Oct. 1, 1969).

A sample of erbium dicarbide was prepared by direct reaction of the elements in a graphite-lined molybdenum crucible. The vaporization of the dicarbide was studied by means of the Knudsen-effusion–mass-spectrometric technique over the temperature range 1750 to 2500°K. The vapor species above $ErC_2(s)$ were found to be Er(g) and, as minor constituent, $ErC_2(g)$. From the vapor-pressure equation the enthalpy of vaporization of $ErC_2(s)$ to Er(g) was found to be $\Delta H^0_{298} = 101.1 \pm 0.4$ kcal/mole. From this value, the standard heat of formation of C-rich $ErC_2(s)$ was calculated to be -18.5 ± 0.4 kcal/mole. The stability of $ErC_2(g)$ molecule was also determined. (auth)

51118 THERMODYNAMICS OF RARE-EARTH–CARBON SYSTEMS. II. THE HOLMIUM–CARBON AND DYSPROSIUM–CARBON SYSTEMS. Balducci, G.; Capalbi, A.; De Maria, G.; Guido, M. (Univ., Rome). J. Chem. Phys., 51: 2871-6(Oct. 1, 1969). (AFML-TR-68-337).

The vaporization of the systems holmium–carbon and dysprosium–carbon was studied by means of the Knudsen-effusion–mass-spectrometric technique. In addition to the gaseous atoms, dicarbide and tetracarbide molecules were identified, and their bond and atomization energies were obtained. The values found are practically coincident for the two systems. A determination of the heats of formation for $HoC_2(s)$ and $DyC_2(s)$ was also made. (auth)

51119 DEVIATIONS FROM STOICHIOMETRIC COMPOSITION AS INFLUENCING DIFFUSION-CONTROLLED PROCESSES IN INTERSTITIAL PHASES. Andrievskii, R. A.; Spivak, I. I.; Tsulin, A. E. Dokl. Akad. Nauk SSSR, 185: 792-4(Apr. 1, 1969). (In Russian).

Deviations from stoichiometry of niobium carbide were correlated with changes in the rate of creep. The composition was varied from $NbC_{0.97}$ to $NbC_{0.83}$. The creep rate was found to be a linear function of the applied force at 2900°C with the creep rate having a higher value for $NbC_{0.97}$ than for $NbC_{0.83}$. The effective diffusions were estimated from the atomic fractions of the metallic and nonmetallic components, their coefficients of self-diffusion, and the concentration of structural vacancies in the nonmetallic sublattice. The agreement between the calculated and experimental data was completely satisfactory. The linear character of the dependence of creep rate as a function of unit stress indicates that directed self-diffusion and nonconservative migration of dislocations play a predominating role in the experimental results. (TTT)

51120 BORON CARBIDE $B_{13}C_2$. Rosso, Jean-Claude; Claire, Yvon. Chim. Ind. (Paris), 101: 607-11(Mar. 1969). (In French).

The preparation of $B_{13}C_2$ by the reduction of B_2O_3 with C is described and the physical properties and structure of the carbide, together with its lattice constants, tabulated. Among chemical properties of the carbide, resistance to oxidation is notably high. Main uses of the carbide at present are in the abrasive field. (Metals Abstr.)

51121 MECHANICAL PROPERTIES OF A SEALING MATERIAL AT ELEVATED TEMPERATURES. Rudenko, V. N.; Belitskii, M. E.; Gorelik, N. N. pp 57-61 of Izdatel'stvo Naukova Dumka, 1967. (In Russian).

Strength tests of the UMB-4S sealing material used in the flow section of high temperature gas turbines were carried out at 20 to 1000°C. The specimens, which were made of Nichrome and boron nitride powders, were prepared by a method developed at the Kiev Engineering Institute of Civil Aviation. The tested specimens were made in three variations: (1) nonsized and sintered in hydrogen; (2) nonsized and sintered in a vacuum; and (3) sized with secondary sintering. The specimens were tested for tensile strength, compressive strength, bending, shearing, and resilience. The test results indicate that the strength and resilience of the investigated specimens gradually decrease with temperature. Specimens sintered in a vacuum have a higher strength than those sintered in hydrogen. Sizing of specimens sintered in hydrogen increases the strength characteristics. (JPRS)

51122 GROWTH OF V_3O_5 AND V_6O_{11} SINGLE CRYSTALS. Nagasawa, Koichi; Bando, Yoshichika; Takada, Toshio (Kyoto Univ., Uji, Japan). Jap. J. Appl. Phys., 8: 1267(Oct. 1969).

V_3O_5 and V_6O_{11} single crystals were grown by the chemical transport reaction method using $TeCl_4$ as transport agent. The compositions of the single crystals were confirmed using powder x-ray and magnetic susceptibility measurements. (D.L.C.)

51123 GROWTH OF V_4O_7 AND V_7O_{13} SINGLE CRYSTALS. Nagasawa, Koichi; Bando, Yoshichika; Takada, Toshio (Kyoto Univ., Uji, Japan). Jap. J. Appl. Phys., 8: 1262(Oct. 1969).

V_4O_7 and V_7O_{13} single crystals were prepared by the chemical transport reaction method, using $TeCl_4$ as the transport agent. Magnetic susceptibility measurements were performed on the single crystals; the results confirm these of Kosuge. (D.L.C.)

51124 TENSILE STRENGTH MODELS FOR PRESTRESSED CONCRETE REACTOR PRESSURE VESSELS. Cordelle, F.; Lida, M.; Ausangee, R. (Electricite de France, Clamart, France). Atomwirt., Atomtech., 14: 309-13(June 1969). (In German).

Data on the tensile strength of prestressed concrete pressure vessels for the Chinon-3, Saint-Laurent-1, and Buget reactors were compiled using small scale models. The techniques, purposes, and limits of such models are discussed on the basis of applications of the numerical results obtained. They confirmed the vessel behavior above the elastic region and produced data on plastic deformation and fracture behavior which could not be obtained by theoretical calculations. For special cases a much smaller scale model than was previously thought usable was sufficient. (tr-auth)

51125 SOME OBSERVATIONS ON THE DEFORMATION CHARACTERISTICS OF BULK POLYCRYSTALLINE ZIRCONIUM HYDRIDES. PART 2. THE DEFORMATION OF ϵ-HYDRIDES. Beevers, C. J.; Barraclough, K. G. (Univ. of Birmingham, Eng.). J. Mater. Sci., 4: 802-8(Sept. 1969).

The compressive deformation of polycrystalline ϵ-zirconium hydride was investigated within the temperature range 22 to ~400°C and over the composition range $ZrH_{1.71}$ to $ZrH_{1.92}$. The observed deformation modes included slip, creation of new lamellae of different orientations to those of the main transformation lamellae, and movement of lamellar boundaries. The results are considered in terms of the contribution of these three processes to the overall deformation behavior. (auth)(UK)

51126 ELECTRICAL RESISTIVITY OF SOME CASTABLE ZIRCONIAS. Meadowcroft, D. B. (Central Electricity Research Labs., Leatherhead, Eng.). J. Mater. Sci., 4: 768-72 (Sept. 1969).

The variation of electrical resistivity with temperature was measured for four castable zirconias: 6.0 mole % calcia-stabilized, 8.5 mole % yttria-stabilized, and 25 and 50 mole % ceria-stabilized zirconia. The calcia- and yttria-stabilized castables required sintering at over 2000°K to develop their electrical conductivity fully, but that of the ceria-stabilized castables was independent of sintering temperature, and similar to that of normally prepared ceramic. The castables are discussed with particular reference to their possible application as MHD electrode materials. (auth)(UK)

51127 THERMOELECTRONIC PROPERTIES OF TaB_2. Burkhanova, V. Kh.; Gorbatyi, N. A.; Sultanov, V. M.; Fekhretdinov, F. A. (Tashkent State Univ.). Zh. Tekh. Fiz., 38: 1356-81 (Aug. 1968). (In Russian).

A comparison was made of the thermionic properties of TaB_2

cathodes prepared by the method of thermal diffusion of boron on a tantalum substrate and the pressing of TaB_2 powders into tablets. Cathodes coated with TaB_2 revealed irreversible deactivation at temperatures above 1800°K, with a change of the Richardson work function from 3.3 to 4.4 eV. In the case of pressed cathodes, heating at temperatures above 2000°K led to a certain deactivation with a change of the Richardson work function from 3.2 to 3.6 eV. However, the emissivity of these cathodes could be restored by adjusting the emission current at a temperature of 1700 to 1800°K. (ATD)

51128 NEW DEVELOPMENTS IN THE FIELD OF CERMETS. Kieffer, R.; Eipeltauer, E.; Gugel, E. (Technische Hochschule, Vienna. Forschungsinstitut der Cremer-Gruppe, Oeslau, Ger.). Ber. Deut. Keram. Ges., 46: 486-92(Sept. 1969). (In German).

Although metal-metal oxide materials as such are not new, in recent times they have gained new significance by the name of cermets. Sintered alloys from hard metallic materials and additives such as for example hard metals should not be included in the cermet group of materials. The nature of the bond in cermets—a compromise combination of favorable and unfavorable properties of the metals and of the oxides—is discussed in detail and the compositions and field of application of both classical and new cermets are outlined. Such combinations as $Mo-ZrO_2$, $Mo-UO_2$, $Ni-ThO_2$ and $SiC-Si$ are technologically interesting examples of cermets. The powder metallurgy, or more precisely the sintering and hot-pressing techniques and the impregnation process have been given an impetus by the development in the field of ceramics. These developments have also had beneficial effects on such fields as those of high-temperature materials, cutting tool ceramics, electronics, space travel, and production of nuclear energy. (auth)

51129 CHANGE OF CRYSTALLITE SIZE AND LATTICE STRAIN OF SMALL CRYSTALLITES UNDER HIGH PRESSURE. Krauth, A. (Max-Planck Institut fuer Silikatforshung, Wuerzburg, Ger.). High Temp. High Pressures, 1: 35-9(1969). (In German).

Changes in lattice strain and crystallite size due to pressure treatment of ZrN and MgO powders with various crystallite sizes were measured by an x-ray method. It was established that the increase in lattice strain due to pressure becomes less the smaller the crystallite size of the initial powder. This can lead to a reduction in the lattice strain in powders subjected to pressure. Large crystallites (>1 μm) subjected to pressure were found to decrease in size to a limit of about 2000 Å, but as the crystallite size in the starting powder decreased, a point could be reached at which there was a coarsening of the crystallites under pressure. The location of this point as a function of the starting crystallite size in the powder is dependent on the material. An explanation of the described effect is suggested. (auth)

51130 KINETICS OF THE INTERACTION OF ZIRCONIUM DIOXIDE WITH CARBON AT HIGH TEMPERATURES. Elyutin, V. P.; Pavlov, Yu. A.; Manukhin, A. V.; Melekhin, V. F. Izv. Vyssh. Ucheb. Zaved., Chern. Met., No. 3, 5-9(Mar. 1969). (In Russian).

Periodic thermographic and chromatographic methods of analysis, enabling experimental data to be obtained in the range 2000 to 2500°C, were used to study the interaction. From data in the literature and the kinetic data obtained, and from the results of chemical analysis it was concluded that the interaction of ZrO_2 with C takes place in three stages: the formation of oxide with an O deficiency, the formation of an oxycarbide of a specific composition, and its transformation to carbide. (Metals Abstr.)

Structure and Phase Studies

Refer also to abstracts 51799 and 51800.

51131 PHASE RELATIONSHIPS IN THE HIGH-LIME PART OF THE SYSTEM $CaO-Nb_2O_5$. Jongejan, A. (Dept. of Energy, Mines, and Resources, Ottawa). J. Less-Common Metals, 19: 193-202(Nov. 1969).

Liquidus temperatures have been determined in the high-lime part of the system $CaO-Nb_2O_5$ with the high-temperature hot-stage microscope. The existence of a compound having the composition $11CaO \cdot 2Nb_2O_5$ and melting congruently at 2105°C was indicated and also the probable existence of a compound with the composition $5CaO \cdot Nb_2O_5$, melting incongruently at 2065°C. Phase relations below 1600°C of compositions near $4CaO \cdot Nb_2O_5$ were interpreted from the results of differential thermal analyses and x-ray diffraction powder patterns of samples quenched from various temperatures. (auth)

51132 COMPLETE ISOTHERMAL CROSS-SECTION (1100°C) OF THE $Nd_2O_3-SrO-B_2O_3$ SYSTEM. Dzhurinskii, B. F.; Tananaev, I. V.; Aliev, O. A. Izv. Akad. Nauk SSSR, Neorg. Mater., 5: 977-8(May 1969). (In Russian).

The isothermal cross-section of $Nd_2O_3-SrO-B_2O_3$ at 1100°C was studied in the region of stratification and isolated compounds of $Nd(BO_2)_3$ and $NdBO_3$ were discovered. The phase diagram of $Nd_2O_3-SrO-B_2O_3$ was constructed and the existence of compounds of $Nd(BO_2)_3$, $NdBO_3$, $Nd_2Sr_3(BO_3)_4$ were confirmed, and the boundaries of the metastable stratification of these systems determined. (tr-auth)

51133 ON THE SOLID STATE REACTION BETWEEN URANIUM OXIDE (U_3O_8) AND MAGNESIUM OXIDE. Negro, A.; Amato, I. (Polytechnic, Turin). J. Less-Common Metals, 19: 159-71(Nov. 1969).

The solid-state reaction in the system U_3O_8-3MgO has been studied by thermodifferential and x-ray analysis. The thermodifferential analysis showed the development, during heating to 1400°C, of three endothermic peaks at 1040, 1200, and 1265°C, respectively, while during cooling from 1400°C, exothermic effects occurred at 1040 and 1090°C. When the heated mixtures were quenched from the temperatures indicated in the thermogram, the first compound to be formed was hexagonal MgU_3O_{10}, which on heating for longer times or at higher temperatures (900 to 1200°C), reacted with residual MgO to form rhombic $MgUO_4$. On heating in the range 1200 to 1265°C the $MgUO_4$ loses oxygen, leading to the formation of $MgUO_{3.5}$ having a fluorite-type structure. The transformation in air is reversible, the rhombic phase being restored on cooling. The presence of two doublets was detected in the $MgUO_4$ pattern. (auth)

51134 STOICHIOMETRY OF UO_2-SiO_2 VITROCERAMICS. Beleuta, I. L. (Inst. for Atomic Physics, Bucharest). J. Nucl. Mater., 33: 124-7(Oct. 1969).

A solid state method of determining UO_2 stoichiometry in vitreous ceramics is described. The UO_{2+x} is reduced in H_2 atmosphere under such thermodynamic conditions that exact stoichiometric UO_2 can be obtained. The reduction treatment does not alter the SiO_2. (J.R.D.)

51135 COMPOSITION AND STRUCTURE OF SAMARIUM CARBIDE. Kyshtobaeva, G. M.; Smagina, E. I.; Kutsev, V. S. Dokl. Akad. Nauk SSSR, 186: 628-30(1969). (In Russian).

Samarium oxide (99.9% pure) and graphite in a ratio of 1 to 7 were carefully mixed, pressed, and fired in an electric furnace at 1900 to 2000°C, and a residual pressure of 10^{-2} mm Hg. Chemical analysis for carbon and samarium were carried out by burning the carbide at a temperature of 1000°C in a current of dry oxygen, and by trapping the carbon dioxide with dry caustic. Oxygen was calculated by difference. Free carbon was determined by dissolving the carbide in 6 N HCl at a temperature of 60 to 70°C for a period of 20 minutes, and by filtering off the free carbon which remains suspended in solution. Since the carbide is rapidly hydrolyzed by moisture in the air, handling operations were carried out in a dry box. The data from the chemical analysis showed that the carbide had a composition of $SmC_{1.7}$. An analysis of the x-ray lines indicated a dicarbide SmC_2 is present that decomposes to samarium metal and free carbon at higher temperature of 1400 to 1650°K. The lattice parameters of the samarium carbide were found to be: a = 5.3200 ± 0.0004 and c = 6.3308 ± 0.0003. (TTT)

51136 ON THE EXISTENCE OF δ-U_3O_8. Herak, R.; Jovanovic, B. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). Inorg. Nucl. Chem. Lett., 5: 693-7(Aug. 1969).

A careful consideration of the available literature leads to the conclusion that some of the reported phases of U_3O_8 do not exist as different phases. The problem of the existence of a δ-U_3O_8 phase and its relation to α- and β-U_3O_8 modifications was investigated by powder and single-crystal x-ray diffraction. The results indicated that the unit cell of "δ-U_3O_8" corresponded to that reported for β-U_3O_8. (UK)

51137 VOID FORMATION AT THE INTERFACE BETWEEN PARTICLES AND MATRIX IN DEFORMED Al–Al_2O_3 FOILS. Ruedl, E. (CCR–EURATOM, Ispra, Italy). J. Mater. Sci., 4: 814-16(Sept. 1969).

Al-foils containing a dispersion of 2.5 wt % Al_2O_3 particles were deformed inside the electron microscope. It was observed that in the necked regions formed voids are nucleated at the particle/matrix interface. These small voids grew with continued straining by elongating and widening. Occasionally elongated voids were pinched off and a row of rather circular loops was left in the matrix. Fracture of particles did not occur. (auth)(UK)

51138 CERAMOGRAPHY OF URANIUM–PLUTONIUM OXIDES. PART I. COPRECIPITATED MIXED OXIDES. Sari, Carlo; Tebaldi, Vittorio; Pithan, Klaus (European Inst. for Transuranium Elements, Karlsruhe, Ger.). Prakt. Metallogr., 6: 556-65(Sept. 1969). (In English and German).

The ceramographic analysis of coprecipitated mixed oxides is reported. The microstructure of the phases (U, Pu)$O_{2.00}$, (U, Pu)$O_2 \pm x$, (U, Pu)$_3O_{8-z}$, (U, Pu)O_{2-x} + Metal, represented in the ternary U–Pu–O phase diagram, have been revealed by chemical and vacuum cathodic etching. The suitable chemical etching agents are HNO_3, H_2SO_4, HNO_3–HF, H_2SO_4–HF, $(NH_4)_2SO_4$–H_2SO_4, HNO_3–H_2O_2. (auth)

51139 LANTHANIDE TELLURATES Ln_6TeO_{12}. Blasse, G. (Philips Research Labs., Eindhoven, Netherlands). J. Inorg. Nucl. Chem., 31: 3335-6(Oct. 1969).

The synthesis and x-ray structures of the compounds Ln_6TeO_{12} (Ln = lanthanide ions, including Y, Sc and In) were investigated. Since no data are known for Sc_6WO_{12} and Sc_6MoO_{12} (required for comparison of structures) an attempt was made to prepare these compounds, the firing temperatures being 1250 to 1450°C. The tungstate had the rhombohedral structure of Y_6UO_{12} while the powder diagram of the molybdate showed only the reflections of Sc_2O_3 and $Sc_2(MoO_4)_3$. (UK)

51140 TRANSITION IN THE α PHASE OF THE LUTETIUM–HYDROGEN SYSTEM. Daou, Joseph N.; Bonnet, Jacques (Faculte des Sciences, Paris). Compt. Rend., Ser. C, 269: 368-71(Aug. 4, 1969). (In French).

Contrary to the other systems of trivalent lanthanide–hydrogen, the lutetium–hydrogen system behaves at all temperatures as a single phase, the alpha phase. At sufficiently high temperatures, this phase consists of an ideal solid solution, with the concentration for saturation increasing with the temperature. At temperatures below 170°C it shows different characteristics implying the peculiar behavior of dissolved hydrogen, the maximum concentration in this case being constant. A hypothesis based on a changing of the type of interstice occupied when the temperature is varied takes into account the results furnished by a study of the resistivity. It would explain in a satisfactory manner the singularities observed for the alpha phase of the Lu–H system compared to the alpha phase of the other Ln(III)–H systems. (tr-auth)

51141 TERNARY OXIDES OF NEPTUNIUM(IV) AND AMERICIUM(III) WITH MOLYBDENUM OR TUNGSTEN. Freundlich, William; Pages, Monique (Institut de Physique Nucleaire, Paris. Laboratoire de Chimie Minerale, Paris). Compt. Rend. Ser. C, 269: 392-4(Aug. 4, 1969). (In French).

A study was made of the systems Np–Mo–O, Np–W–O, Am–Mo–O, and Am–W–O, and identification of the ternary oxides formed was made by x-ray diffraction. Evidence is presented for solid solutions of the constitution $Np_xTh_{1-x}Mo_2O_8$ with hexagonal structure. (tr-auth)

Radiation Effects

Refer also to abstract 52403.

51142 (BNWL-tr-43) STRUCTURE AND PROPERTIES OF (U, Pu)O_2 CONTAINING INACTIVE FISSION PRODUCTS. A SIMULATION OF IRRADIATED NUCLEAR FUEL. Schmitz, Franz (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Translated by E. R. Appleby (Battelle-Northwest, Richland, Wash.), from report CEA-R-3795. 38p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 23: 32070.

51143 (GA-9675) RESEARCH ON GRAPHITE. Quarterly Progress Report for the Period Ending August 14, 1969. Engle, G. B.; Bokros, J. C.; Price, R. J. (Gulf General Atomic, Inc., San Diego, Calif.). Aug. 27, 1969. Contract AT(04-3)-167. 25p. Dep. CFSTI.

Studies to determine the degree of graphitization in a number of moderator graphites were completed. Anisotropic graphites consist of up to 10 vol-% semigraphitic regions coexisting with highly graphitic regions, whereas near-isotopic graphites are predominantly semigraphitic with smaller amounts of crystalline material that is highly aligned. Calcined petroleum cokes are under study to determine the effect of calcined density on crystalline growth. Metallic additives are being studied as an aid to low-temperature graphitization of compacts fabricated with aluminum-doped petroleum coke. A series of compacts was fabricated and baked at 900°C to evaluate the effect of aluminum content on the ratio of graphite conversion at 2100 to 2300°C. Microhardness measurements were completed on titanium-doped and titanium-free pyrocarbons annealed for 1 hr at 100°C temperature increments between their deposition temperature and 3000°C. The hardness decreased during annealing paralleling the crystal growth, as is shown by x-ray diffraction. This behavior is explained by the relation between the effective elastic modulus and the crystallite size in carbons. The influence of the pitch-binder content on the microstructure and physical properties and irradiation behavior of needle-coke graphites is under investigation. Additional density measurements on loose needle-coke particles and compacts show that crystallite clusters expand more rapidly during irradiation in the loose particles than in compacts where they are restrained by binder coke. A series of anisotropic and near-isotropic graphites is being irradiated to 15×10^{21} n/cm^2 at 1000 to 1250°C. A series of samples of hot-worked graphite, as-deposited massive pyrocarbon, and annealed massive pyrocarbon is under in-pile irradiation at approximately 1250°C and approximately 800°C. Microhardness measurements were completed on samples of irradiated pyrocarbon annealed to temperatures at 100°C intervals between 400 and 3000°C. Annealing took place over the range of approximately 1400 to 2600°C. The isochronal annealing curves were similar in shape to those observed previously for the dimensions and crystallographic parameters. Irradiation-induced dimensional changes in a variety of pyrolytic carbons at 900 to 1000°C and at 1200 to 1300°C show that during the irradiation the rate at which the specimens change dimensions accelerates. The accelerations are most pronounced in dense, isotropic carbon and are accompanied by the generation of pores in the structure, which cause a volume expansion. At 900°C, the accelerations are primarily caused by a degradation in crystal structure that enhances the instability of the crystallites. At the higher irradiation temperatures, increases in anisotropy contribute significantly to the accelerations. The volume expansions, the degradation of the crystal structure, and the changes in thermal conductivity are all less for irradiations above 1200°C than for irradiation at 1000°C. Micrographic evidence was obtained to show highly oriented regions in granular pyrocarbons coexisting with isotropic regions. These regions behaved differently during high-temperature irradiation at high doses, but this behavior did not cause disintegration of the pyrocarbon. (auth)

51144 (GAMD-9276) IRRADIATION-INDUCED DIMENSIONAL CHANGE IN BORONATED GRAPHITE: RESULTS OF THE BG-1 (GA-19-1) EXPERIMENT. Stansfield, O. M.; Sandefur, N. L. (Gulf General Atomic, Inc., San Diego, Calif.). July 29, 1969. Contract AT(04-3)-167. 48p. Dep. CFSTI.

Boronated graphites containing 21 to 35 wt % boron and fabricated by extrusion or warm-pressing techniques were irradiated at 650 ± 100°C to fast neutron exposures of 2×10^{21} to 4×10^{21} n/cm^2, which was similar to 2 to 4 year exposure in a High Temperature Gas-Cooled Reactor (HTGR). The specimens were shielded from thermal neutrons so that a ^{10}B burnup gradient (35 to 80%) developed across the 0.2 in. width of some specimens. The irradiation caused an increase in the coefficient of thermal expansion and a decrease in thermal conductivity. The flexure strength was unchanged. Dimensional changes of the extruded and warm-pressed specimens are given. Expansion of boronated graphite in both directions was favored by increasing fast-neutron exposure. Non-boronated warm-pressed graphites contracted more in the perpendicular direction and expanded less in the parallel direction than boronated graphites at the same exposure. Comparison of nonboronated and boronated warm-pressed graphites showed that the addition of B_4C granules to the graphite matrix produced enhanced expansion at a given exposure even when the ^{10}B content of the B_4C was reduced to produce a relatively inert B_4C particle. Several mechanisms that might act to accelerate expansion in boronated graphite were discussed. In spite of the uncertainties about the mechanisms leading to dimensional change, the absence of a significant size or shielding effect seems well established. Direct use of boronated graphite irradiation data, rather than treating these data in analytical models, would therefore provide the most reliable prediction of absorber dimensional change during HTGR service. (G.M.C.)

51145 (KFK-980) MELTING PHENOMENA IN UO_2-IRRADIATED EXPERIMENT. Geithoff, D. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). May 1969. 27p. (In German). (EUR-4177). Dep. CFSTI (U. S. Sales Only).

In oxide fuel test samples partially melted under irradiation, the melt cavities and the ceramic structure were studied. Penetration by betatron-produced x rays was used as the investigation method for the melt cavity. It was shown that the cavity form is dependent on the type and duration of irradiation. Typical forms for long-time, short-time, and cycle irradiations could be distinguished. The ceramographic determination of the melting

limits in a fuel cross section was confirmed with the help of β,γ autoradiography and the cavity projection. Indications on the flow behavior of molten uranium dioxide could be obtained on the basis of ceramic ground sections. (tr-auth)

51146 (RISO–199) METALLURGY DEPARTMENT ANNUAL PROGRESS REPORT FOR THE PERIOD ENDING MARCH 31, 1969. (Danish Atomic Energy Commission, Risoe. Research Establishment). May 1969. 41p. Dep. CFSTI (U. S. Sales Only).

The research work in reactor metallurgy was centered on problems connected with fuel elements for power and research reactors and steel for pressure vessels. The general material research was concentrated on strength-structure relationships in single-phase and two-phase materials. The fuel-element work was concerned with zircaloy uranium dioxide elements for water-cooled power reactors as well as with plate fuel elements for research reactors. The first phase of the zircaloy uranium dioxide fuel-element program was completed by the insertion of eight elements in the Halden reactor in Norway. One element was unloaded from the reactor according to schedule after reaching a burn-up of 2900 MWd/t. At the end of the year reported upon, seven elements were being irradiated in Halden; the highest burn-up reached, in two elements, was about 6000 MWd/t. The development work was mainly in the fields of argon-arc welding, non-destructive quality control and surface treatment of zircaloy cladding tubes. The work on irradiation and post-irradiation examination consisted in developing, together with the Reactor Department, in-pile facilities for fuel-pin irradiation under boiling-water conditions and, together with the Hot Cell Section, techniques for examination of irradiated fuel elements. A number of fuel pins containing uranium dioxide pellets and vibratory-compacted uranium dioxide have been irradiated in the DR 3 reactor and are being examined in the hot cells. The research work on cladding materials on a zirconium basis included corrosion testing of a number of advanced zirconium alloys and studies of hydride formation. In collaboration with the UKAEA the joint program involving dispersion-strengthened zirconium materials was continued, and a number of strong zirconium yttrium oxide products are being examined by vacuum creep testing. Under an agreement between the atomic energy establishments in England, Norway, Sweden, and Denmark, advanced zirconium alloys are studied. Emphasis is given to the system zirconium-chromium-iron; the work at Risö is concentrated on corrosion testing at elevated temperatures and on the effect of heat treatment and of irradiation on the distribution of the intermetallic phase. The research concerning uranium dioxide included work on the relations between powder characteristics and pressing and sintering behavior. A program on the thermal conductivity of uranium dioxide under irradiation was continued with in-pile measurements in DR 3; the maximum burn-up reached so far is about 4000 MWd/t. The work on vibratory compaction was continued with irradiation in DR 3 and in the Halden reactor. Fuel pins irradiated in DR 3 to a burn-up in the range 1000 to 2000 MWd/t were examined in the hot cells and showed a satisfactory behavior. The highest burn-up reached in vipac pins is 8700 MWd/t. Experimental work in the field of general material research included studies of the strength-structure relations for single phase-and two-phase materials. For single-phase materials the effect of grain size on the flow properties at room temperature and at elevated temperature was examined for aluminum and magnesium oxide. For two-phase materials, dispersion-strengthened products on aluminum, zirconium and stainless steel bases were examined together with fiber-reinforced copper. Problems of specific interest were the work-hardening behavior of the matrix, the high-temperature strength and the interfacial relation. As one result of the work on dispersion-strengthened aluminum aluminum oxide products it was found that the flow stress of commercial SAP products can be explained on the basis of current theories of dispersion strengthening. Other experiments were concerned with the study of texture development by rolling of face-centered cubic polycrystals and correlating experimental findings with results obtained by a computer simulation of the texture formation. In the field of powder metallurgy, research was carried out in milling, powder classification, and sintering. Also projects were carried out concerning the effect of forming operations on the mechanical properties of aluminum and zirconium and standardization of the destructive testing of brazings. Among other experiments in general metallurgy may be mentioned corrosion experiments concerned with the distribution of intermetallics in the surface corrosion film and studies of gas absorption and permeability of different alloys. (auth)

51147 (UCRL–71703) IRRADIATION STUDIES OF URANIUM NITRIDE. Albrecht, E. D.; Rothman, A. J.; Lee, J. D.; Johnson, J. M.; Hayes, W. N. Jr. (California Univ., Livermore. Lawrence Radiation Lab.). Aug. 15, 1969. 36p. (CONF-690910–4). Dep. CFSTI.

From Symposium on Developments in Irradiation Testing Technology, Sandusky, Ohio.

A fission-heated, gas-bonded, binary gas controlled irradiation capsule containing eight uranium nitride specimens has been irradiated at 1307 to 1417°C during the irradiation at an average burn-up of 2.3×10^{20} fissions/cc. Two specimens each of four different microstructures, including fine-grain (30 microns), 96% dense; coarse-grain (105 microns), 97% dense; single crystal, 100% dense; and fine-grain (30 microns), 78% dense fuel were irradiated for a total of 3558 hours. The 9.6% enriched specimens were nominally 0.750 in. in length and 0.200 in. in outside diameter, having a 0.100-in.-diameter axial hole. Each specimen was composed of from one to three segments, with the lower segment of the single-crystal specimens remaining an undrilled solid piece. The fuel specimens were clad in vented W-25.5 Re having a wall thickness of 0.020 in. To prevent decomposition of the uranium nitride, a partial nitrogen pressure was maintained during the irradiation by external heating of U_2N_3 powder located at the bottom of the capsule. Neutron radiographs were made of the capsule before irradiation and at the conclusion of each cycle, in an attempt to acquire progressive swelling data during the irradiation. An extensive post-irradiation examination was made which included measurements of lengths, inside diameters, outside diameters, density, metallographic parameters, composition, and determination of uranium burn-up. The only significant changes observed in the microstructure were the creation of fine porosity at the grain boundaries of all polycrystalline specimens and the preferential alignment of this porosity in those grain boundaries lying parallel to a specimen surface. The single-crystal specimens did not exhibit the porosity except in rare occasions along subgrain boundaries near the surface. Retained fission gas analyses by mass spectrometric techniques have shown that nearly 100% of the fission gas generated has been retained in each specimen, regardless of microstructure. The fine grain (30 microns), 96% dense UN swelled the greatest amount at 1417°C and to a lesser extent at 1347°C, revealing an implied temperature dependence. The fine-grain (30 microns), 78% dense and single-crystal, 100% dense UN showed the least swelling under the conditions of this irradiation. (auth)

51148 EFFECTS OF FAST-NEUTRON IRRADIATION ON PYROLYTIC SILICON CARBIDE. Price, R. J. (Gulf General Atomic Inc., San Diego, Calif.). J. Nucl. Mater., 33: 17-22 (Oct. 1969).

Samples of pyrolytic polycrystalline β-silicon carbide were irradiated to 2.0 to 4.2×10^{21} nvt (E > 0.18 MeV) at temperatures between 460 and 1040°C. The samples showed an isotropic linear expansion that decreased with increasing irradiation temperature from 0.35 % at 460°C to 0.05% at 1040°C. The lattice parameter changes were equal to the macroscopic dimensional changes within experimental accuracy. Irradiation caused a slight increase in x-ray line broadening that was attributable to the generation of internal strains. There was no significant change in Young's modulus or the modulus of rupture. (auth)

51149 GRAIN-BOUNDARY GAS RELEASE AND SWELLING IN HIGH BURN-UP URANIUM DIOXIDE. Bellamy, R. G.; Rich, J. B. (Atomic Energy Research Establishment, Harwell, Eng.). J. Nucl. Mater., 33: 64-76(Oct. 1969).

Miniature UO_2-stainless steel fuel pins were irradiated in DIDO at 0.8 to 5.0% burnup. Center fuel temperatures were calculated from chemical burnup and heat transfer data and were calibrated from grain growth observations in unirradiated material. On this basis center temperatures did not exceed 1630°C. Fission gas release was compatible with diffusional release and knock-out models up to about 2% burnup. Above 3% burnup a large increase in gas release occurred in both diffusional and nondiffusional regimes. Apparent diffusion coefficients were strongly sensitive to the initial fuel density at the lower burnup, but at the higher burnup they were relatively independent of this parameter. With increasing burnup, fission gas bubbles accumulate at grain boundaries and later smaller fission gas bubbles form within the grains. Thermal stress cracking was entirely transgranular up to 2% burnup; at 3% burnup some intergranular cracking was seen, and at 5% burnup extensive areas of predominantly circumferential grain boundary cracking appeared. The marked increase in gas release above 3% burnup is believed to arise in part from the interconnection of grain boundary gas bubbles and in part from the fracture under thermal stress of grain boundaries weakened by gas bubbles. At high burnups the specific surface areas calculated from gas release values approach the grain boundary surface area; it is suggested that the increase in the apparent diffusion coefficient with burnup is essentially an increase in the specific surface area and

not in the true diffusion coefficient. The disappearance of small residual pores even at low temperatures is believed to indicate an irradiation-enhanced sintering process and is associated with some densification of the fuel. At higher temperatures grain boundary porosity is stabilized, probably by fission gases. An incubation period of 2% burnup was observed before diametral expansions of the cladding became significant. This is usually ascribed to the initial accommodation of swelling in internal voidage. However, even in pins of 97% smeared density the incubation period is not greatly lower than that reported for fuel of only 80% density. It is concluded that the voidage in the high density pins is being used more efficiently than that in the low density fuel pins. (auth)

51150 STUDY OF THE BEHAVIOR OF STATIC CHARGE IN RADIOACTIVE NEODYMIUM OXIDE. Spitsyn, Vikt. I.; Pirogova, G. N.; Sopina, A. A.; Enikeev, E. Kh. (Inst. of Physical Chemistry, Moscow). Dokl. Akad. Nauk SSSR, 186: 1358-61(1969). (In Russian).

The difference in potential between radioactive neodymium oxide and a standard electrode over a temperature interval of 130 to 400°C was determined by using a vibrating condenser. Pressed neodymium oxide pellets were irradiated in a reactor at a neutron flux of 1.2×10^{13} neutrons/cm^2-sec for a period of 22 hours to give an induced ^{147}Nd activity of 6 to 8 mCi/g. The potential difference was measured in a vacuum of 10^{-5} to 10^{-6} mm Hg. The difference in potential varied linearly with the specific activity: $V = V_0 + kA$. Here V is the difference in potential. V_0 is a hypothetical value of the difference in potential at zero specific activity; k is a portionality coefficient with dimensions of grams/millicurie, and A is the specific activity. The value of k depends on the temperature, and decreases exponentially with increasing temperature. Potential differences up to 100 volts can be obtained. The difference in potential is due to the formation of a significant positive charge on the surface of the radioactive sample as a result of beta decay. (TTT)

Plastics and Other Materials

Refer also to abstracts 49840, 49841, 49847, 49866, 50994, 52268, 52482, 52485, and 52486.

51151 (N-69-30549) STUDY OF SPACE ENVIRONMENT EFFECTS ON THERMAL CONTROL COATINGS: DEPENDENCE OF THERMAL CONTROL COATING DEGRADATION UPON ELECTRON ENERGY. Final Report. Fogdall, Lawrence B.; Cannaday, Sheridan S. (Boeing Co., Seattle, Wash. Aerospace Group). May 1969. Contract NAS5-11164. 125p. (NASA-CR-103205; D-2-126114-1). CFSTI.

The effects of 20, 50, and 80-keV electrons on the reflectance of selected types of thermal control coatings and surfaces were studied and compared. Both diffuse and specular materials of current interest for space application were exposed in the dark in a 10^{-8} torr vacuum to electron fluences as great as 10^{16} electrons/cm^2. The types of coatings and surfaces tested included diffuse white paints, a metallic gray paint, Kapton, metallized Teflon and lacquer, aluminum, and overcoated aluminum. The hemispherical spectral reflectance of each test specimen was measured in vacuum before and after exposure, using an integrating sphere, a monochromator, and a continuous wavelength scan technique between 0.25 and 2.5 microns. Plots of reflectance or reflectance changes as function of wavelength were obtained by computer-processing of test data, and are presented. It was concluded that reflectance degradation in most materials studied is strongly dependent upon electron energy. Relative effectiveness of 20-, 50-, and 80-keV electrons for causing spectral reflectance degradation was determined for those coatings showing sufficient damage. (auth) (STAR)

51152 LONG LIFE MATERIALS FOR SPACECRAFT. Markowitz, Leonard; Scannapieco, John F.; Babjak, Steven J. (General Electric Co., Valley Forge, Pa.). Sci. Advan. Mater. Process Eng. Proc., 13: 51-82(1968).

From 13th National Symposium and Exhibit, Chicago, Ill. See CONF-680554.

The structural and thermal design of current and future generations of spacecraft involves the utilization of lightweight structural materials and stable thermal control coatings, capable of surviving the combined effect of solar radiation and particulate bombardment in a thermal-vacuum environment for relatively long periods of time. The evaluation of various materials which exhibit a high degree of dimensional and functional stability when subjected to this type of environment is presented. (auth)

51153 IMPROVEMENT OF THE THERMOMECHANICAL BEHAVIOR OF CABLE INSULATOR GRADE POLYETHYLENE EXPOSED TO IONIZING RADIATION. Kosa-Somogyi, Istvan; Toth, Laszlo; Kertesz, Zoltan. KFKI (Kozp. Fiz. Kut. Intez.) Kozlem., 17: 237-48(1969). (In Hungarian).

The softening temperature of cable insulator grade polyethylene irradiated with ^{60}Co gamma rays was observed to shift on the absorption of doses from 30 to 40 Mrad gradually to higher temperatures until no more softening could be established on the absorption of doses from 80 to 100 Mrad. The tensile strength of polyethylene irradiated with gamma rays was found to be 120 to 200 kg/cm^2 at room temperature after the absorption of 30 to 150 Mrad. The tensile strength gradually decreases with increasing temperatures and was measured as 5 to 10 kg/cm^2 in the temperature range from 250 to 300°C. (auth)

51154 INSULATIONS AND JACKETS FOR CONTROL AND POWER CABLES IN THERMAL REACTOR NUCLEAR GENERATING STATIONS. Blodgett, Robert B.; Fisher, Robert G. (Okonite Co., Passaic, N. J.). IEEE (Inst. Elec. Electron. Eng.), Trans. Power App. Syst., PAS-88: 529-41(May 1969).

Whether cables insulated and jacketed with elastomer-(polymer-) based material can be expected to perform satisfactorily in the containment and lower radiation level areas outside the containment vessel of thermal reactors is considered. The permanent change in the physical strength rate of oxidation, dielectric loss, and electrical stability in 40-psig (142°C) steam and dielectric strength are reported for 13 elastomer-based insulation-jacket combinations after ^{60}Co irradiation up to 10^8 rad in air at 5×10^5 rad/hr. Threshold of damage for each property, overall threshold of damage, and highest dose rate still serviceable for the combinations are summarized. Dimethylsilicone-based insulations are suitable at their usual 130°C temperature rating only in low-radiation environments, because of its sensitivity to steam and its poor resistance to oxidation after radiation. Carbon black-filled (and probably clay-filled) cross-linked polyethylenes insulations are suitable at 105°C up to class-3 radiation levels, when protected with suitable flame-resistant braids. Butyl and high-density polyethylenes when properly jacketed are suitable at their usual 90°C temperature rating only up to class-2 radiation levels. Nonfilled cross-linked polyethylenes and oil-base insulation, when properly jacketed, are suitable at their usual 90°C temperature rating. Styrene-butadiene rubber and polyvinylchloride (PVC) based coverings are suitable only at relatively low temperatures and radiation levels; PVC's are sensitive to hot water and steam when exposed to more than 5×10^5 rad. Neoprene, chlorosulfonated polyethylene (CSPE), or chlorinated polyethylene (CPE) jackets are suitable at their usual 70°C temperature rating up to 10^7 rad. The radiation limit is based on oxidation effects; flame resistance is not affected by radiation. It is believed that the most attractive combination of materials for thermal nuclear generating plants will be CSPE- or CPE-jacketed insulations based on nonfilled cross-linked polyethylene. Such cables should last at least 40 yr when exposed to a total radiation dose up to 5×10^7 rad and will still be serviceable after exposure up to 10^8 rad. (BBB)

PHYSICS (GENERAL)

Astrophysics and Cosmology

Refer also to abstract 51818.

51155 NONTHERMAL PHENOMENA OF ASTROPHYSICS AND THEIR RELATION TO PLASMA PHYSICS. Cameron, A. G. W. (Yeshiva Univ., New York. Goddard Space Flight Center, New York). pp 1-16 of Plasma Instabilities in Astrophysics. Wentzel, Donat G.; Tidman, Derek A. (eds.). New York, Gordon and Breach, Science Publishers, Inc., 1969.

From International Conference on Plasma Instabilities in Astrophysics, Pacific Grove, Calif. See CONF-681042.

The various fields of astrophysics are discussed in general. Topics discussed are the following: (1) solid bodies, (2) stellar phenomena, (3) supernova envelopes, (4) interstellar medium, (5) pulsars, (6) galactic cosmic rays, (7) radio galaxies, and (8) quasars. (M.O.W.)

Cosmic Ray Exposure Ages

51156 PLASMA INSTABILITIES IN ASTROPHYSICS. Conference Held in Pacific Grove, California, October 14–17, 1968. Wentzel, Donat G.; Tidman, Derek A. (eds.). New York, Gordon and Breach, Science Publishers, Inc., 1969. 425p. (CONF-681042).

Separate abstracts were prepared for 19 of the included papers. (M.O.W.)

For abstracts of individual papers see: 51155, 51169, 51230, 51275–51279, 51315, 51316, 51405, 51523, 51524, 51652, 51692–51695, and 51821.

51157 ALLENDE METEORITE: AGE DETERMINATION BY THERMOLUMINESCENCE. Durrani, S. A.; Christodoulides, C. (Univ. of Birmingham, Eng.). Nature (London), 223: 1219-21 (Sept. 20, 1969).

An attempt is described to measure the age of this meteorite, which fell in Mexico on Feb. 8, 1969, by the thermoluminescence method. (auth)(UK)

Stars

Refer also to abstract 51998.

51158 SLOW VARIATIONS IN THE BETA LYRAE SYSTEM. Alduseva, V. Ya. (Shternberg Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.), 13: 286-7(Sept.-Oct. 1969).

Translated from Astron. Zh., 46: 363-5(Mar.-Apr. 1969).

Absolute spectrophotometric gradients Φ_λ for β Lyrae in the photographic spectral region are derived from observations of the ultraviolet spectrum at the Shternberg Astronomical Institute's high-altitude station during 1961–1963, and monochromatic light curves at wavelengths of 4000 and 4500 Å are obtained. Differences between the 1961–1962 and 1963 observations of the β Lyr system are found for the value and behavior of Φ_λ as a function of phase, the shape of the light curve, and the integrated brightness. (auth)

51159 AN ANALYSIS OF THE CN ABSORPTION BANDS IN THE SPECTRUM OF NOVA HERCULIS 1934. Antipova, L. I. (Astronomical Council, Moscow). Sov. Astron. AJ (Engl. Transl.), 13: 288-94(Sept.-Oct. 1969).

Translated from Astron. Zh., 46: 366-75(Mar.-Apr. 1969).

An analysis was made of the cyanogen absorption bands observed in the spectrum of Nova Herculis 1934 immediately after maximum light. The number of CN molecules along the line of sight at the epoch of maximum light on December 22, 1934, and the number near the time of greatest CN intensity on December 28 were evaluated as $(N_{CN})_1 = 3.90 \cdot 10^{14}$ and $(N_{CN})_2 = 3.43 \cdot 10^{15}$ respectively. Several arguments are given to show that the temperature of the radiation responsible for the dissociation of the molecules during this period remained constant. Calculations based on the dissociation equation were performed under this assumption. It is found that the sharp rise in the number of CN molecules evidently resulted from a short-term contraction of the nova envelope immediately after maximum light ($l_1/l_2 \approx 100$). Such a contraction would have been expected, in view of considerations developed by other authors. The very high value for the absolute intensity of the CN bands at the epoch of their maximum (December 28) was in itself caused by the anomalously high content of C and N atoms in the nova envelope. (auth)

51160 GENERATION OF STELLAR MAGNETIC FIELDS BY CONVECTIVE MOTIONS IN THE SURFACE LAYERS. Ponomarenko, Yu. B. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Sov. Astron. AJ (Engl. Transl.), 13: 295-302(Sept.-Oct. 1969).

Translated from Astron. Zh., 46: 376-85(Mar.-Apr. 1969).

The development of convective motions in slowly rotating stars is considered. It is shown that as convection develops a magnetic field is generated, and axisymmetric convective motions induce differential rotation. An interpretation is offered for the large-scale motions and fields on the Sun. (auth)

51161 SPATIAL ORIENTATION OF THE ORBIT PLANES OF CLOSE BINARY STARS. Shakhovskoi, N. M. (Crimean Astrophysical Observatory, Moscow). Sov. Astron. AJ (Engl. transl.), 13: 303-5(Sept.-Oct. 1969).

Translated from Astron. Zh., 46: 386-8(Mar.-Apr. 1969).

Polarization measurements for nine eclipsing binary systems yield the positions of the lines of nodes of their orbits and the inclinations of their orbit planes to the galactic plane. The resulting evidence suggests a random orientation for the orbit planes of close binary systems. (auth)

51162 THE GLOBULAR CLUSTERS M3 AND M5. Zhukov, L. V. (Central Astronomical Observatory, Pulkovo, USSR). Sov. Astron. AJ (Engl. Transl.), 13: 306-15(Sept.-Oct. 1969).

Translated from Astron. Zh., 46: 389-401(Mar.-Apr. 1969).

The photometric and kinematic properties of 764 stars in the vicinity of the globular cluster M3 and 1141 stars in the vicinity of the globular cluster M5 were used to discriminate cluster members from background stars. Members were identified through two criteria: the proper motions of the stars (Ebbighausen's criterion) and the (V, B−V) diagram (the photometric criterion). An application of only one of these criteria is shown to be inadequate for a rigorous identification of member stars. The (V, B−V) diagrams are prepared for stars in the clusters M3 and M5 that with high confidence are cluster members. The systems of RR Lyrae variables in the cluster neighborhoods are investigated. According to Ebbighausen's probability criterion, the great majority of RR Lyrae variables are shown to belong to the clusters, confirming the view that RR Lyrae stars in the vicinity of clusters are genetically related to the clusters themselves. A method is developed for determining the dimensions of clusters by using stellar proper motions over an extended neighborhood of a cluster. An application of two versions of the method to the clusters M3 and M5 indicates that the dimensions of the clusters are almost twice the values presently accepted. The angular radii of the clusters M3 and M5 are 17.5′ and 20′ respectively, rather than 9.3′ and 10′, as given by Sawyer. (auth)

51163 APPLICATION OF NONLINEAR LIMB-DARKENING LAWS TO CLOSE BINARY SYSTEMS. Kiperman, M. E.; Shul'berg, A. M. (Odessa Astronomical Observatory, USSR). Sov. Astron. AJ (Engl. Transl.), 13: 324-9(Sept.-Oct. 1969).

Translated from Astron. Zh., 46: 412-18(Mar.-Apr. 1969).

The nonlinear limb darkening corresponding to a nongray model atmosphere of an early-type star is considered. The brightness distribution is approximated by linear and nonlinear laws. For the case of total eclipse in a close binary system whose eclipsed component exhibits nonlinear limb darkening, a solution of the light curve yields the best value for the linear limb-darkening coefficient, with the inevitable deviations from the theoretical curve expressed in stellar magnitudes. (auth)

51164 REMARKS ON ARIFOV AND KADYEV'S PAPER, THE RELATIVISTIC THEORY OF ANNUAL PARALLAXES. Mikhailov, A. A. (Central Astronomical Observatory, Pulkovo, USSR). Sov. Astron. AJ (Engl. Transl.), 13: 358-9(Sept.-Oct. 1969).

Translated from Astron. Zh., 46: 454-5(Mar.-Apr. 1969).

Arifov and Kadev's claim that trigonometric stellar parallaxes require a positive correction because of the curvature of light rays in the Sun's gravitational field is shown to be erroneous. (auth)

51165 NEUTRINO RADIATION BY THE URCA PROCESS AT HIGH TEMPERATURES. Nadezhin, D. K.; Chechetkin, V. M. (Inst. of Applied Mathematics, Moscow). Sov. Astron. AJ (Engl. Transl.), 13: 213-18(Sept.-Oct. 1969).

Translated from Astron. Zh., 46: 270-7(Mar.-Apr. 1969).

The radiation of energy by the URCA process in the form of neutrinos and antineutrinos is calculated. The nuclear reactions are assumed to be in statistical equilibrium (with $T > 4 \times 10^9$°K),

and β processes in nuclei and free nucleons in kinetic equilibrium. With these two assumptions one can uniquely determine the chemical composition of the material and find the rate of energy loss by neutrino radiation as a function of temperature and density. The region where the URCA process definitely predominates over all other process is ascertained. An estimate is made for the influence on the neutrino radiation of nuclei overenriched with neutrons which have not yet been detected experimentally. (auth)

51166 OBSERVATIONS OF THE FILAMENTARY NEBULA IC 443 IN THE Hα LINE WITH A FABRY–PEROT INTERFEROMETER. Lozinskaya, T. A. (Shternberg State Astronomical Inst., USSR). Sov. Astron. AJ (Engl. Transl.), 13: 192-6 (Sept.-Oct. 1969).

Translated from Astron. Zh., 46: 245-9(Mar.-Apr. 1969).

A series of observations was made of the nebula IC 443 in the Hα line with a Fabry–Perot interferometer and a contact image-converter tube as a radiation detector. The following quantities were determined: the radial velocity of the nebula, reduced to the local rest standard, +6 km/sec (the root-mean-square error of one measurement was 4 km/sec); an expansion velocity of 65 km/sec ±7 km/sec; and a half-width of the Hα line due to thermal and turbulent motions of 50 km/sec ±10 km/sec. All the data refer to the bright part of the remnant of the supernova explosion, to the IC 443 nebula proper. (auth)

51167 SURVEY OF THE REGION OF LACERTA OB1. Coyne, George (Woodstock Coll., Md.); Burley-Mead, Jaylee; Kaufman, Michele. Astron. J., 74: 103-7(Feb. 1969).

Spectral classes and photographic magnitudes were determined for a total of 3621 stars in the region of the association Lac OB1. Astrophotometer measures of images on glass reproductions of the Palomar Sky Survey plates were used for the photometry, and spectral classes were determined by using color equivalents according to the Tikhoff method. The star counts indicate that there is an excess of early A stars on the main sequence in the concentrated region of the association as compared to the dispersed region. Also, the total area of the survey shows a deficiency of stars later than F5 when comparison is made to counts in nearby selected areas. It is recommended that membership determinations be made for the A stars which constitute the clustering in the concentrated region of the association. (auth)

51168 A SEARCH FOR PERIOD CHANGES BY THE VARIABLES IN M13. Osborn, Wayne (Yale Univ., New Haven). Astron. J., 74: 108-12Feb. 1969).

The total available observational material for the four well-observed variable stars in M13 was considered together. Improved periods were obtained and it is shown that Variable 2 has undergone a lengthening of its period since 1900. Forty-one recent observations of these stars are also presented. (auth)

51169 ROLE OF THE MAGNETIC FIELD IN STAR FORMATION. Mestel, L. (Univ. of Manchester, Eng.). pp 329-52 of Plasma Instabilities in Astrophysics. Wentzel, Donat G.; Tidman, Derek A. (eds.). New York, Gordon and Breach, Science Publishers, Inc., 1969.

From International Conference on Plasma Instabilities in Astrophysics, Pacific Grove, Calif. See CONF-681042.

Topics considered in detail include gravitational collapse and fragmentation of a magnetic gas cloud, star formation in rotating magnetic clouds, and magnetic braking by stellar winds. (W.D.M.)

51170 COLOR EXCESS AND ATOMIC HYDROGEN AT HIGH LATITUDES. Sturch, Conrad (Univ. of Rochester, N. Y.). Astron. J., 74: 82-4(Feb. 1969).

The intensity of the 21-cm line in the direction of a number of RR Lyrae stars is compared with color excesses of these stars. A positive correlation between dust and atomic hydrogen is confirmed and some of the large scatter observed is attributed to combining data from various galactic regions. (auth)

51171 WAVELENGTH DEPENDENCE OF POLARIZATION. XIII. INTERSTELLAR EXTINCTION AND POLARIZATION CORRELATIONS. Serkowski, K. (Australian National Univ., Canberra); Gehrels, T.; Wisniewski, W. Astron. J., 74: 85-90(Feb. 1969).

Observations of the wavelength dependence of polarization and UBVRI photometry of highly polarized stars were made. Two extreme cases of the wavelength dependence of the interstellar polarization were found: the maximum polarization of stars HD 147889 and 204827 is observed at 0.8 and 0.4 μ, respectively. The variations of interstellar extinction in the infrared are correlated with the wavelength of maximum polarization. Van de Hulst's theory of light scattering by infinite cylinders is used to explain the correlations. (auth)

51172 STELLAR RADIAL VELOCITIES DERIVED FROM MICROPHOTOMETER MEASUREMENTS. Lutz, Thomas E.; Yoss, Kenneth M. Astron. J., 74: 91-5(Feb. 1969).

A method is outlined for measuring line positions with a precision-screw microphotometer, with subsequent reduction of the data in a computer. The resulting stellar radial velocities have internal accuracies comparable to those obtained through conventional measuring procedures. (auth)

51173 BACKGROUND DENSITY AND THE PHOTOGRAPHIC DETECTION OF FAINT STARS. Millikan, Allan G. (Eastman Kodak Co., Rochester, N. Y); Yutzy, Jan. Astron. J., 74: 96-7(Feb. 1969).

An astrosensitometer was used to determine the relation between background exposure density and the limit of detection of faint stellar objects for a series of Kodak spectroscopic plates. Differing spectral sensitization within a given emulsion type gave similar results for detection limit vs background density. For Kodak spectroscopic plates commonly used in astronomy, exposure should be sufficient to produce a background ASA diffuse density of at least 0.6. The tolerance for underexposure on three of the four plate types studied was considerably less than the tolerance for overexposure. (auth)

51174 ULTRAVIOLET SPECTROPHOTOMETRY OF EARLY-TYPE STARS. Stecher, Theodore P. (Goddard Space Flight Center, Greenbelt, Md.). Astron. J., 74: 98-102Feb. 1969).

Stellar energy distributions in the ultraviolet were obtained by objective-grating spectrometers mounted in spinning rockets. The resolution was 100 Å and the data were corrected for interstellar extinction. The resulting spectra of stars ranging in spectral type F5IV–O5f and WC7 are presented and discussed. (auth)

51175 A STUDY OF THE POSITIONS AND PROPER MOTIONS OF 83 STARS IN THE REGION OF SCO X-1. Sofia, Sabatino; Eichhorn, Heinrich; Gatewood, George (Univ. of South Florida, Tampa). Astron. J., 74: 20-4(Feb. 1969).

From astrographic plates taken over an interval of 63 yr, proper motions and/or positions of the x-ray source Sco X-1 and 82 other stars in its surrounding area were derived in the system of the SAOC (i.e., FK4), using the plate overlap technique. A study of these proper motions indicates that the x-ray source is probably a member of a physically coherent group, which may be the Scorpio–Centaurus association. In this case, the distance of 200 pc and Population I type of this source would be established. (auth)

51176 LOW-LUMINOSITY MEMBERS OF THE HYADES CLUSTER. II. van Altena, W. F. (Univ. of Chicago, Williams Bay, Wis.). Astron. J., 74: 2-19(Feb. 1969).

New proper motions have been determined for over 700 stars in the Hyades region. These have been combined with proper motions from other sources, thus giving the most accurate proper motions available for faint Hyades members. New photoelectric observations are presented for 37 faint stars in the Hyades region. The color–magnitude diagram for probable members exhibits a narrow main sequence to the limit of the photoelectric observations, $V \simeq 15$ or $M_V \simeq +12$. Several subluminous late-type stars with photoelectric colors lie 2 to 4 mag below the main sequence but still above the white-dwarf sequence, and are probable members. Of three Flare stars in the Hyades region, two are probable members. Eleven white dwarfs are probable members of the Hyades cluster, but an additional four white dwarfs previously considered to be members are shown to be nonmembers. The Hyades white dwarfs lie on a line defined by $V = 14.24 + 1.36\,(B-V)$ with a scatter of ±0.12 mag (m.e.). New calibrations based on trigonometric parallaxes for white dwarfs in the field yield the following relationships for the two sequences: upper, $M_V = +11.00 + 1.36\,(B-V)$; lower, $M_V = +12.65 + 2.67\,(B-V)$. The slope of the upper-sequence relationship has been taken equal to that of the Hyades white dwarfs. Based on the upper-sequence relationship, the distance modulus of the Hyades is found to be $m-M = +3.23 \pm 0.08$ mag (p.e.). This value, when averaged with values derived by other methods, yields a distance modulus for the Hyades of $m-M = +3.23 \pm 0.05$ mag (p.e.), or a correction of +0.20 mag to the currently accepted value. This correction is within the +0.3-mag limit of error for the distance modulus as derived from Wayman's convergent-point method. (auth)

51177 SHORT-PERIOD VARIABILITY OF B, A, AND F STARS. II. PHOTOMETRY OF NEW DELTA SCUTI STARS. Breger, Michel (Univ. of California, Berkeley). Astron. J., 74: 166-76(Mar. 1969).

Photoelectric data for 15 more short-period variables, as well as one suspected variable discovered during a recent variability survey among bright field stars, are given. The periods range

from 0.042 to 0.16 days and some amplitudes are as small as 0.01 mag in visual light. (auth)

51178 TWELVE-COLOR STELLAR PHOTOMETRY. Wood, David B. (Bellcomm, Inc., Washington, D. C. Kitt Peak National Observatory, Tucson, Ariz.). Astron. J., 74: 177-89(Mar. 1969).

A wide-baseline color system designed primarily for studying galaxy synthesis is described, which utilizes seven filters placed in continuum regions, and five filters placed on certain absorption features. Observations of 93 standard stars later than B7, and of all luminosity classes are presented and the relationship of the observations with temperature, luminosity, and metal abundance investigated. A color index based upon the Mgb and MgH absorption features near λ5175 is particularly useful for luminosity resolution for stars of spectral type G5 and later. It is also strongly sensitive to metal abundance. (auth)

51179 ABSOLUTE MAGNITUDES AND INTRINSIC COLORS OF OB STARS. Herr, Richard B. (Univ. of Delaware, Newark). Astron. J., 74: 200-8(Mar. 1969).

OB classifications in the Cleveland system have been related to the MK system. Based on published calibrations of the MK types, the OB classes (OB^-, OB, and OB^+, respectively) have M_V's of -3.6, -4.8, and -5.9; $(B-V)_0$'s of -0.26, -0.27, and -0.28; and $(U-B)_0$'s of -0.92, -1.01, and -1.05. A finer subdivision within the Cleveland system is found to be meaningful and is also calibrated. Individual consideration is given to the emission OB types and to stars whose spectra appear reddened. (auth)

51180 POSSIBLE HORIZONTAL-BRANCH STARS AT HIGH GALACTIC LATITUDES. III. Philip, A. G. Davis (State Univ. of New York, Albany. Kitt Peak National Observatory, Tucson, Ariz. Cerro Tololo Inter-American Observatory, La Serena, Chile). Astron. J., 74: 209-10(Mar. 1969).

Positions, spectral types, and B magnitudes are presented for ten new possible field horizontal-branch stars, selected from lists of faint A stars by means of measures made in the four-color system of Strömgren. (auth)

51181 THE LIGHT VARIATION AND ORBITAL ELEMENTS OF TZ BOOTIS. Binnendijk, L. (Univ. of Pennsylvania, Philadelphia. Kitt Peak National Observatory, Tucson, Ariz.). Astron. J., 74: 211-17(Mar. 1969).

A total of 514 photoelectric observations in yellow light and 510 observations in blue light of TZ Bootis were made on four nights during 1967. The heights of the maxima show a large difference which suggests a large complication in the system. The secondary minimum is caused by a total eclipse. However, the light does not remain constant during totality but gradually becomes brighter. Provisional orbital elements were derived. (auth)

51182 PHOTOELECTRIC OBSERVATIONS OF V502 OPHIUCHI. Binnendijk, L. (Univ. of Pennsylvania, Philadelphia. Kitt Peak National Observatory, Tucson, Ariz.). Astron. J., 74: 218-23(Mar. 1969).

A total of 491 observations in yellow light and 485 observations in blue light of V502 Ophiuchi are presented. The large complication in this system with partial eclipses prevents any reliable orbital determination. (auth)

51183 LIGHT DELAYS NEAR A RELATIVISTIC STAR. Atkinson, R. d'E. (Indiana Univ., Bloomington). Astron. J., 74: 320-34(Mar. 1969).

The delays which photons experience, if they are emitted from a highly relativistic star, are computed in terms of the positions of their apparent origins on the disk seen by a distant observer. Compared with a photon emitted radially, differential delays as long as the "circular period" occur only for photons whose apparent origin is in the outermost $1/_{10}$ of the disk radius. The circular period is 1.606×10^{-4} $M/M_\odot$ seconds, and in a free-fall collapse there is a very large drop in luminosity in this time; Podurets' formula as corrected by Ames and Thorne is equivalent to an increase of 6.822 magnitudes per circular period, or 42.5 magnitudes per millisecond at one solar mass. Thus, if a highly condensed star is to be observable, there can be no approach to free fall, and the hypothetical case of no appreciable decrease in luminosity even in times considerably longer than the circular period is discussed. In that case, the intensity is constant all over the apparent disk if there is no limb darkening for a local observer. The form of the observed pulse, if the star emits a pulse that is infinitely sharp, can then be directly computed from the delays. The curve rises vertically to a peak and starts falling off again at once in a roughly exponential manner; it falls to half the initial height in 0.025 $M/M_\odot$ ms, and pulses can thus be observed falling to half strength in $1/_{10}$ ms if $M \leq 4$ $M_\odot$. A large number of deflections are also calculated; it is difficult to obtain sharp pulses from a "directional spot" on a rotating star if relativistic effects are large, since the deflections widen the beam very greatly. (auth)

51184 CARBON STARS IN A SOUTH GALACTIC POLE REGION. Slettebak, Arne; Keenan, Philip C.; Brundage, Richard K. (Ohio State Univ., Columbus. Ohio Wesleyan Univ., Delaware). Astron. J., 74: 373-4(Apr. 1969).

Seven carbon stars, four of which are new, were detected in an objective-prism survey covering 840 square degrees centered on the south galactic pole. With the exception of the bright variable R Scl, all are early R-type stars, at distances between 2 and 5 kpc from the galactic plane. (auth)

51185 A STUDY OF THE BRIGHT A STARS. I. A CATALOGUE OF SPECTRAL CLASSIFICATIONS. Cowley, Ann (Univ. of Michigan, Ann Arbor); Cowley, Charles; Jaschek, Mercedes; Jaschek, Carlos. Astron. J., 74: 375-406(Apr. 1969).

Two-dimensional spectral classifications are given for about 1700 bright A stars north of $-21°$. The magnitudes and colors were taken from the "Catalogue of Photometric Data" in preparation at La Plata Observatory. (auth)

51186 FOUR-COLOR AND H-BETA PHOTOMETRY OF OPEN CLUSTERS. II. COMA AND URSA MAJOR. Crawford, David L.; Barnes, Jeannette V. (Kitt Peak National Observatory, Tucson, Ariz.). Astron. J., 74: 407-12(Apr. 1969).

Photoelectric photometry is presented for 38 stars of the Coma Cluster and for 10 stars of the Ursa Major Cluster. The data are compared to the standard relations valid for the Hyades Cluster, and it is concluded that (1) there is no interstellar reddening in front of the clusters; (2) the F-type stars in the Hyades have c_1 indices for a given β (or color) larger than stars in Coma or stars along the "zero-age" relation; (3) the Coma and Ursa Major F stars have less blanketing (average δm_1 is 0.014 m) than the Hyades stars; (4) the distance modulus for the Coma Cluster is 4.5 m and for the Ursa Major is 1.8 m; (5) the scatter about mean relations for the F stars indicates that cosmic scatter — whether due to differences in rotation velocity or other causes — must be quite small. (auth)

51187 CHANGES IN THE NEAR-INFRARED SPECTRA OF FIFTY-ONE RED VARIABLE STARS. Terrill, Chris L. (Case Western Reserve Univ., Cleveland). Astron. J., 74: 413-32 (Apr. 1969).

Objective-prism spectra in the near infrared (6800 to 8800 Å) were used to follow the spectral variations of 51 Mira, semiregular, and irregular variable stars during a time span of more than a decade. Thirty-one of the variables are M stars, 19 are S, and R CMi is a weak carbon star. For the S stars showing TiO bands, temperature classes are assigned by giving equivalent M-type classifications based on the TiO. Diagrams are given showing temperature class vs light phase for 23 Mira and SRa variables which are well observed by the AAVSO. Temperature class variations correlate well with light variations, and there is a tendency toward spectrum being defined by magnitude independently of phase on a given branch of the light curve. Amplitude of spectral variation is greatest when the light amplitude is greatest. A composite magnitude vs spectrum diagram for M stars indicates that the temperature class changes more rapidly with magnitude for spectral types of M6 and earlier, than for later types. This is attributed to a change in the classification criteria between M6 and M7. Diagrams are given showing the variations of LaO at λ7909 and ZrO at λ6474 with phase for the S-type Mira variables observed by the AAVSO. One S star, S Lyr, shows bands of CN near maximum, in strength normally seen only in carbon stars. An emission feature seen near λ8400 in the spectra of S stars near minimum is tentatively identified. (auth)

51188 GENERAL RELATIVISTIC NEUTRON STAR MODELS. Heintzmann, H. (Institut fuer Theoretische Physik, Cologne). Astron. Astrophys., 3: 243-6(Oct, 1969).

Two topics of general relativity are reconsidered with the help of an exact solution of Einstein's field equations. An upper limit for the number of baryons of a stable neutron star and for the mass defect due to gravitational binding are given. It is shown further that stable hyperon stars may exist with mean densities a hundred times greater than nuclear density. These can only be formed by catastrophic processes. (auth)

51189 ELECTRIC FIELD IN NEUTRON STARS. Bhatia, M. S.; Bonazzola, S.; Szamosi, G. (Univ. of Windsor, Ont.). Astron. Astrophys., 3: 206-9(Oct, 1969).

The general-relativistic conditions for simultaneous hydrostatic and chemical equilibrium in a spherical neutron star are

given. The critical mass does not change appreciably but a small outward radial electric field appears in the star as a result of the displacement of electrons from the core of the star. (auth)

51190 GRAVITY DARKENING IN THE COMPONENTS OF CLOSE BINARY SYSTEMS. Peraiah, A. (Northern Coll. of Applied Art and Tech., Kirkland Lake, Ont.). Astron. Astrophys., 3: 163-8(Oct. 1969).

The variation of temperature and brightness on the surface of the components of close binary systems was investigated, taking account of nonuniform rotation and tidal effects of the other component considered as mass point. The equations for such surfaces had been developed in terms of the mass ratio of the two components (m_2/m_1); ratio of the equatorial radius of the primary to the distance between the centers of gravity of the two components (r_e/R); ratio of centrifugal to gravity forces at the equator (f); and the ratio of angular velocities at the equator and the pole (x). When these equations are used to compute the temperature and brightness distributions by using different values for the above mentioned parameters, it was observed that temperature and brightness fall very rapidly between 45° colatitude and the equator. Higher temperatures tend to reduce gravity darkening due to tidal effect. The fall in brightness is steeper than that of temperature. These results are compared with those of Ireland by putting $m_2 = 0$. (auth)

51191 DIFFERENTIAL FINE ANALYSIS SIRIUS VERSUS VEGA. Gehlich, U. K. (Hamburger Sternwarte, Hamburg). Astron. Astrophys., 3: 169-78(Oct. 1969).

Differential chemical abundances for Sirius and Vega are determined by means of model atmosphere analysis. The parameters of the model atmospheres are found to be $T_{eff} = 9700°K$, $\log g = 4.3$, $\xi_t = 2.0$ km/s (Kohl, 1964a) for Sirius and $T_{eff} = 9200°K$, $\log g = 4.0$, $\xi_t = 3.5$ km/s for Vega. Nearly all metals are more abundant in Sirius than in Vega. However, Sirius does not meet all Am-star criteria. Remaining uncertainties in the abundance differences are mainly due to the errors of the measured equivalent widths of the lines in the spectrum of Vega. (auth)

51192 RADII OF THE COMPONENTS OF 31 Cyg. Johansen, Karen T. (Copenhagen Univ.). Astron. Astrophys., 3: 179-85 (Oct. 1969).

The eclipsing binary 31 Cyg has components of spectral type K3.5Ib and B4V. The supergiant consists of a star of almost sharp edge and an extended atmosphere. For the light curve of the primary minimum the eclipsing effect of the extended atmosphere has been removed and the radii of the components determined. The photometric elements were computed in case of an eclipsing star with a sharp edge and also for a star where the optical depth along the line of sight has been determined from model atmosphere calculations. In case of central eclipse the radius of the B star is found equal to 7.2 $R_\odot$, which is a value too large for the spectral type B4V. In case of a noncentral eclipse smaller values of the B star radius are found. Due to the uncertainty of the orbit dimensions and assumptions made, a definite value of the orbital inclination is not presented but it is concluded that the eclipse may not necessarily be central. The equations valid for an atmospheric eclipse are presented and explained in detail. (auth)

51193 ROLE OF THE CREATION E IN THE STELLAR NUCLEOSYNTHESIS. Joukoff, A. A. (Univ. Libre, Brussels). Astron. Astrophys., 3: 186-96(Oct. 1969). (In French).

The bound-state beta decay theory (β^- emission towards a bound electronic state of the formed atom) is developed for any nuclear transition, based on the electron capture theory. The relative rates of bound-state beta decay compared with ordinary β^- emission for allowed transitions, first forbidden in parity, and first unique forbidden transitions which generally are predominant in astrophysical applications are calculated. For heavy elements, the bound-state beta decay overrules the ordinary disintegration up to nuclear energies of the order of 2 mc^2 for allowed and first forbidden in parity transition and of the order of 3 mc^2 for first unique transitions. The bound-state beta decay thus appears as a nonnegligible phenomenon every time one comes across low-energy transitions. The synthesis of 8 elements rich in protons (^{80}Kr, ^{94}Mo, ^{106}Cd, ^{120}Te, ^{126}Xe, ^{132}Ba, ^{152}Gd and ^{164}Er) are studied by branchings of the s-capture chains of neutrons at the stage of carbon burning. These branchings are favored by the bound-state beta decay contribution (factors 1.3 to 109 according to the case); it reduces the lifetime of the element situated on the main s chain from which the branching is made. The relative equilibrium abundances are given, calculated by taking and not taking into account the bound-state beta decay, in order to evaluate the real importance of this phenomenon. It is shown that appreciable quantities of ^{80}Kr, ^{126}Xe, ^{132}Ba, ^{152}Gd, and ^{164}Er can be formed by such a process, this one being particularly effective for ^{80}Kr and ^{164}Er synthesis; these two elements are effectively situated on the main chain in favorable conditions, the others being always situated on a more or less weak branching. The process appears as not very effective for the ^{94}Mo and ineffective for the ^{106}Cd and the ^{120}Te. (auth)

51194 TREATMENT OF PULSATING WHITE DWARFS INCLUDING GENERAL RELATIVISTIC EFFECTS. Cohen, Jeffrey M. (Goddard Space Flight Center, New York); Lapidus, Arnold; Cameron, A. G. W. Astrophys. Space Sci., 5: 113-25 (Sept. 1969).

Pulsating white dwarfs are treated via general relativity. Numerical integration of Einstein's equations was used to find equilibrium white dwarfs models and the fundamental periods of small oscillations about these equilibrium models. In these calculations account was taken of Coulomb, Thomas–Fermi, and exchange interactions as well as ion zero point energies. It is shown that general relativity makes not just a quantitative difference in the results but a qualitative difference; pure ^{12}C models which are stable in Newtonian mechanics can be unstable against collapse (at a central density of 3×10^{10} g/cm^3) when general relativity is taken into account. The collapsing model may become a neutron star or may continue towards the Schwarzschild radius. More realistic white dwarf models with carbon-burning products at the center also were studied. For these models, the density at which the star becomes unstable against collapse due to electron capture (3×10^9 g/cm^3) was found to be lower than the density at which general relativistic instability occurs. (auth)

51195 PARTICLE DIFFUSION IN DEGENERATE, IONIZED GASES. Rosen, Leonard C. (Yeshiva Univ., New York, Univ. of California, Livermore). Astrophys. Space Sci., 5: 92-102 (Sept. 1969).

A perturbation treatment is used to find the distribution functions from the Boltzmann transport equation for a two-component ionized, degenerate gas. General expressions are found for the diffusion coefficient and relative diffusion velocity. Tables are given for specific values of spin and mass ratio. (auth)

51196 FAST EVOLUTION TOWARDS THE WHITE DWARFS. Deinzer, W.; Hansen, C. J. (Joint Inst. for Lab. Astrophysics, Boulder, Colo.). Astron. Astrophys., 3: 214-21(Oct. 1969).

Four evolutionary sequences of stellar models were investigated numerically to improve upon an earlier attempt by Deinzer to explain some puzzling features in the evolution of the central stars of planetary nebulae. The present models consist of highly contracted, semi-degenerate, isothermal cores containing a large fraction of the stellar mass, and radiative envelopes of very small mass content which are capable of large contractions within short timescales. The evolutionary track of sequence I is very similar to the track obtained earlier by Deinzer under the same starting conditions, but with certain simplifying assumptions. The evolutionary time-scale of sequence I, however, is much shorter than the 10^4 years estimated in the earlier paper, if the envelope contains only 10^{-4} of the total mass. Models with envelopes containing a few percent of the stellar mass are shown to evolve at about the desired time scale of 10^4 years (Sequences II and III). Sequence IV, starting from a model in which the luminosity transported throughout the envelope decreases towards the outside (in the preceding cases it was assumed to be constant), has an increase in luminosity before descending towards the white dwarf state, thus becoming topologically similar to the empirical sequence. (auth)

51197 MASSES OF STARS ABOVE THE MAIN SEQUENCE. Stephenson, C. B.; Sanwal, N. B. (Case Western Reserve Univ., Cleveland). Astron. J., 74: 689-704(June 1969).

85 visual binaries with published orbits, 162 other visual binaries (physical pairs) exhibiting relative proper motion between the components, and 29 double-line eclipsing binaries were considered to derive mean masses of stars above the main sequence as a function of position in the H–R diagram. Spectrograms for 270 systems (some of which, for which data are also presented, turned out to be dwarfs) were newly obtained with the Cassegrain spectrograph for the purpose of classifying the spectra in the MK system. For the physical pairs the mean masses were derived by a statistical method, some details of which are new. The basic results are given and show that, within the spectral range depicted, post main-sequence evolution proceeds without dramatic mass loss. (auth)

51198 A CATALOGUE OF FOUR-COLOR PHOTOMETRY OF LATE F-TYPE STARS. Perry, Charles L. (Louisiana State Univ., Baton Rouge. Kitt Peak National Observatory, Tucson, Ariz.). Astron. J., 74: 705-17(June 1969).

The uvby photometry obtained at Kitt Peak National Observatory is listed for the majority of F5–G0 stars in the General Catalogue

within both the magnitude interval 6.5 to 7.5 and the declination zone −10° + 60°. (auth)

51199 INVESTIGATION OF A NEW LONG-PERIOD VARIABLE. Hess, S.; Hoffleit, D.; Osborn, W. (Yale Univ., New Haven). Astron. J., 74: 718-20(June 1969).

Investigation of the newly discovered variable CoD −35°4257 shows the star to have a primary period of 502 days superimposed on a secondary beat period of about 3000d. The spectral type of the star was found to be late N. (auth)

51200 THE M7 GIANTS IN THE NUCLEAR BULGE OF THE GALAXY. Spinrad, Hyron (Univ. of California, Berkeley); Taylor, Benjamin J.; van den Bergh, Sidney. Astron. J., 74: 525-8(May 1969).

Photoelectric observations of the color and titanium oxide strength in the M8.5 III star V1398 Sgr, which is located in the nuclear bulge of the Galaxy, are compared with similar data for late-type giants near the Sun. The color observations show that the late spectral type of V1398 Sgr is not due to misclassification resulting from a superabundance of the metals. The fact that V1398 Sgr has a light amplitude ΔB of only 0.6 mag at spectral type M8.5 III suggests that the stars in the nuclear bulge of the Galaxy differ from those near the Sun. Possibly the observed differences between the pulsation characteristics of M stars near the Sun and in the nucleus of the Galaxy are due to a difference in helium and (or) heavy element abundance. (auth)

51201 WAVELENGTH DEPENDENCE OF POLARIZATION. XVII. BE-TYPE STARS. Coyne, G. V.; Kruszewski, A. (Univ. of Arizona, Tucson). Astron. J., 74: 528-32(May 1969).

Polarimetric observations of 19 Be-type stars are presented. A typical wavelength dependence for the polarization of such stars involves a rise toward a secondary maximum at $1/\lambda = 1.06\ \mu^{-1}$ and a sharp decrease in the ultraviolet polarization. This is explained as self absorption by hydrogen of the polarization produced by scattering from electrons in the envelopes of these stars. (auth)

51202 UBV PHOTOELECTRIC PHOTOMETRY OF EPSILON CORONAE AUSTRALIS. Tapia, S. (Univ. of Chile, Santiago, Cerro Tololo Inter-American Observatory, La Serena, Chile). Astron. J., 74: 533-7(May 1969).

Light and color curves of ε CrA are presented. Colors remain constant throughout the period within one-hundredth of magnitude. The period was found to be constant in the last 17 years. (auth)

51203 PHOTOELECTRIC OBSERVATIONS OF THREE W URSAE MAJORIS SYSTEMS. Brown, B. M. K.; Pinnington, E. H. (Univ. of Alberta, Edmonton). Astron. J., 74: 538-43(May 1969).

Photoelectric observations using the blue and yellow filters are described for three W Ursae Majoris systems: VW Cephei, 44i Bootis, and W Ursae Majoris. Times of minimum light are given with an accuracy of ±0.0005d. An examination of the differences between the observed and computed times of minimum light indicates that the period of VW Cephei continues to decrease, while that of W Ursae Majoris continues to increase. The data for 44i Bootis indicate little change in period over the past ten years. (auth)

51204 1 TO 4 MICRON SPECTRA OF FOUR CARBON STARS AND SIRIUS. Thompson, Rodger I. (Massachusetts Inst. of Tech., Cambridge); Schnopper, Herbert W.; Mitchell, R. I.; Johnson, H. L. Astrophys. J., 158: L55-60(Oct. 1969).

Infrared spectra of four carbon stars and Sirius, obtained with a Michelson interferometer, are presented at a resolution of 9 cm^{-1}. Bands due to C_2, $^{12}C^{16}O$, and $^{13}C^{16}O$ are found in the carbon stars, and the hydrogen Brackett series is found in Sirius. The carbon monoxide bands appear to be saturated in the carbon stars. (auth)

51205 OB STARS NEAR THE SUPERNOVA REMNANT RCW 86. Westerlund, Bengt E. (Univ. of Arizona, Tucson). Astron. J., 74: 879-81(Sept. 1969).

The filamentary nebula RCW 86, identical with the nonthermal radio source MSH 14−63, is part of a supernova remnant. A group of OB stars is found near the radio source. The distance of the group is 2500 pc; this agrees well with the radio distance of the remnant. It is suggested that the remnant was formed by the explosion of a member of the group; the explosion occurred probably in 185 A. D. (auth)

51206 INTERNAL MOTIONS IN THE ASSOCIATIONS II PER AND I LAC. Lesh, Janet Rountree (Yerkes Observatory, Williams Bay, Wis.). Astron. J., 74: 891-8(Sept. 1969).

New proper motions and spectroscopic data for the bright members of the associations II Per and I Lac are analyzed to determine whether these two groups are in a state of expansion. For II Per, the expansion age is calculated as 1.3×10^6 yr ± 9% (p.e.), in agreement with earlier investigations (Blaauw 1952; Delhaye and Blaauw 1953). The concentrated and dispersed regions of the Lacerta association are found to have mean distance moduli differing by about 1 mag. This effect appears to be real, and not the result of a systematic error in the calibration or of an intrinsically under-luminous main sequence in the younger subgroup. The concentrated subgroup, Ib Lac, has an expansion gradient corresponding to a kinematic age of 2.5×10^6 yr ± 19% (p.e.). It is unlikely that systematic errors in the proper-motion system could account for this result. (auth)

51207 PHOTOMETRIC STUDIES OF SOUTHERN GALACTIC CLUSTERS. I. IC 2391. Perry, Charles L. (Louisiana State Univ. Observatory, Baton Rouge. Cerro Tololo Inter-American Observatory, La Serena, Chile); Hill, Graham. Astron. J., 74: 899-907(Sept. 1969).

Multicolor photometry is presented for 42 stars in the vicinity of the southern galactic cluster IC 2391. Independent analyses of UBV and uvby−Hβ data confirm that IC 2391, with a membership of 25 stars, is an unreddened cluster at a distance of 150 pc. These analyses show that the absolute magnitude calibrations and intrinsic color relations derived from both UBV and uvby−Hβ photometry are in good agreement. A nuclear age of 30×10^6 yr and a lower limit to the contraction age of 30×10^6 yr were obtained for the cluster. The uvby−Hβ data fit the standard relations of the Hyades Cluster although there is only limited overlap for the fainter members. (auth)

51208 FREQUENCY OF SPECTROSCOPIC BINARIES AMONG HIGH-VELOCITY DWARF STARS. Abt, Helmut A.; Levy, Saul G. (Kitt Peak National Observatory, Tucson, Ariz.). Astron. J., 74: 908-16(Sept. 1969).

A sample of 68 F- and G-type high-velocity dwarf stars was studied for velocity variations and is compared with available data regarding low-velocity dwarf stars. It is concluded that short-period binaries are rare among all high-velocity dwarfs and are especially infrequent for the weakest-lined stars, although the frequency of long-period or visual binaries may be similar among high- and low-velocity stars. (auth)

51209 MK CLASSIFICATIONS FOR F- AND G-TYPE STARS. I. Harlan, E. A. (Univ. of California, Santa Cruz). Astron. J., 74: 916-19(Sept. 1969).

New MK spectral classifications are given for 314 stars between magnitudes 5.0 and 7.5, mainly of types F and G. The assignments were made on slit spectrograms of dispersion 75 Å/mm at Hγ. (auth)

51210 H_α AND H_β PHOTOELECTRIC PHOTOMETRY FOR 80 BRIGHT STARS. Tebbe, Paul L. (Georgetown Coll. Observatory, Washington, D. C.). Astron. J., 74: 920-4(Sept. 1969).

H_α and H_β indices were obtained by interference-filter methods. Straight-line transformations of the β indices were made to the Crawford and Mander (1966, Astron. J. 72: 114) standard system. The technique of using α and β indices together, as described by Abt and Golson (1966, Astrophys. J. 143: 306) was used to obtain a good separation of B-type supergiants from Be stars. (auth)

51211 PHOTOMETRY OF POPULATION II CEPHEIDS IN GLOBULAR CLUSTERS. I. M2. Demers, Serge (Cerro Tololo Inter-American Observatory, La Serena, Chile). Astron. J., 74: 925-8(Sept. 1969).

U, B, V, photographic photometry of the four variables in M2 with periods longer than one day is presented. The plates are calibrated with a new photoelectric sequence. Mean magnitudes and colors are determined from the light and color curves. As has been noted before, Population II Cepheids show little change of color with periods. (auth)

51212 GIANT M STARS IN THE GALACTIC ANTICENTER. McCuskey, S. W. (Case Western Reserve Univ., Cleveland). Astron. J., 74: 807-11(Aug. 1969).

The space density of giant stars of spectral groups M0−M1, M2−M4, and M5−M8 was evaluated as a function of distance for an 8-sq-deg area at the galactic anticenter, $l^{II} = 186°$, $b^{II} = +1°$. Objective-prism spectra in the red, infrared, and V magnitudes are the observed data for 493 stars. The M stars decrease in number with distance from the Sun in the anticenter direction as follows: M0−M1 stars, D(r) = 9.5 to 2.5 stars per 10^6 pc^3, $1 < r < 5$ kpc; M2−M4 stars, D(r) = 4.0 to 2.5 in the same interval; M5−M8 stars, D(r) = 1.0 to 0.25 per 10^6 pc^3 in the interval $2 < r < 5$ kpc. (auth)

51213 POSSIBLE HORIZONTAL-BRANCH STARS AT HIGH GALACTIC LATITUDES. IV. Philip, A. G. Davis (State Univ. of New York, Albany. Kitt Peak National Observatory, Tucson, Ariz. Cerro Tololo Inter-American Observatory, Arecibo, Puerto Rico). Astron. J., 74: 812-13(Aug. 1969).

Positions, B magnitudes, and spectra are given for ten new possible field horizontal-branch stars in high galactic latitude regions. (auth)

51214 THE H-R DIAGRAM OF NGC 2516. Abt, H. A. (Cerro Tololo Inter-American Observatory, Arecibo, Puerto Rico); Morgan, W. W. Astron. J., 74: 813-15(Aug. 1969).

The open cluster NGC 2516 is found to contain an Mn II star, three Si II stars, and a pronounced shell star. The cluster seems to be unique in the variety of peculiar stars present, which include several showing the line at λ3984 (identified by Bidelman with Hg II) in their spectra. (auth)

51215 ROS 4, A DISTANT OPEN CLUSTER ASSOCIATED WITH NEBULOSITIES. Racine, Rene (Carnegie Institution of Washington, D. C. California Inst. of Tech., Pasadena). Astron. J., 74: 816-17(Aug. 1969).

Photoelectric UBV photometry is reported for thirteen apparent members of Ros 4, an open cluster associated with nebulosities. A photometric distance of 2900 ± 300 pc is derived. The position of the cluster in the Galaxy suggests that the local (Orion) arm exists as a continuous feature over a length of at least 4 kpc. (auth)

51216 FOUR-COLOR AND H-BETA PHOTOMETRY OF OPEN CLUSTERS. III. PRAESEPE. Crawford, David L.; Barnes, Jeannette V. (Kitt Peak National Observatory, Tucson, Ariz.). Astron. J., 74: 818-23(Aug. 1969).

Photoelectric observations are presented for 97 stars of the Praesepe open cluster, and are compared with standard relations valid for the Hyades cluster. Three stars are identified as definite nonmembers. The average color excess relative to the Hyades and nearby field stars is E (b−y) <0.01 m; four stars are perhaps reddened about 0.04 m. The F-type stars in Praesepe show the same effect noted in the Hyades; they deviate from the "zero-age" line in a c_1 vs β relation. The calculated distance modulus for the cluster is 6.1 m, agreeing well with previous determinations. Rotational velocity effects on the observed parameters do not appear to affect any of the above conclusions. (auth)

51217 PHOTOMETRIC DETERMINATIONS OF MAGNITUDE DIFFERENCES FOR VISUAL BINARIES. Worley, Charles E. (Naval Observatory, Washington, D. C.). Astron. J., 74: 764-7(Aug. 1969).

Visual photometric Δm determinations for 94 double stars are presented, and the accidental and systematic errors discussed. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstract 51175.

51218 (NYO-1932(2)-152) PULSAR TEST OF A VARIATION OF THE SPEED OF LIGHT WITH FREQUENCY. Feinberg, G. (Columbia Univ., New York. Dept. of Physics). [1969]. 8p. Dep. CFSTI.

The sharply defined optical and radio pulses from pulsars allow a test of the variation of the speed of light with frequency, and of the possible existence of a photon mass. The data indicates that real photons have a mass less than 5×10^{-45} g. Detection of extragalactic pulsars could allow a substantial improvement of this limit. (auth)

51219 THE RADIO BRIGHTNESS DISTRIBUTION OF THE CRAB NEBULA AT 32.5 cm WAVELENGTH. Matveenko, L. I. (Lebedev Inst. of Physics, Moscow). Sov. Astron. AJ (Engl. Transl.), 13: 197-204(Sept.-Oct. 1969).

Translated from Astron. Zh., 46: 250-9(Mar.-Apr. 1969).

The procedures and results of lunar occultation observations of the Crab Nebula at 32.5 cm are discussed. The radio-brightness distribution of the nebula is given; this is similar to the optical, but the peripheral regions and individual bright features are relatively more outstanding. (auth)

51220 X-RAY EMISSION ACCOMPANYING THE ACCRETION OF GAS BY A NEUTRON STAR. Zel'dovich, Ya. B.; Shakura, N. I. (Moscow Univ.). Sov. Astron. AJ (Engl. Transl.), 13: 175-83(Sept.-Oct. 1969).

Translated from Astron. Zh., 46: 225-36(Mar.-Apr. 1969).

Accretion of gas by a neutron star and the spectrum of the radiation emitted in this process are discussed. The entire treatment applies to the spherically symmetric case. A systematic and internally consistent method is developed for calculating the physical parameters of the atmosphere of a neutron star and the electromagnetic radiation spectrum. Calculations are performed under two assumptions regarding the mean free path of the incident protons: (1) that the protons are decelerated by pair collisions with the particles in the atmosphere, and (2) that collective plasma oscillations would serve to reduce the mean free path. The computed spectrum differs considerably from a Planck curve, particularly in the second case. (auth)

51221 REFRACTION AND SCATTERING OF RADIATION FROM COSMIC RADIO SOURCES OCCULTED BY THE SOLAR CORONA. Bliokh, P. V.; Sinitsyn, V. G.; Fuks, I. M. (Inst. of Radiophysics and Electronics, Kiev). Sov. Astron. AJ (Engl. Transl.), 13: 275-82(Sept.-Oct. 1969).

Translated from Astron. Zh., 46: 348-58(Mar.-Apr. 1969).

The propagation of a plane electromagnetic wave in the spherically symmetric outer solar corona is investigated. The angular distribution of radiation intensity is calculated in the geometric-optics approximation with both regular refraction and scattering by electron-density fluctuations taken into account. The variation of the total intensity (integrated flux) with the position of the observer relative to the caustic curve is investigated. (auth)

51222 NEGATIVE-CURVATURE SPECTRA OF DISCRETE SOURCES. Vaisberg, V. V. (Inst. of Radiophysics and Electronics, Kharkov). Sov. Astron. AJ (Engl. Transl.), 13: 205-9 (Sept.-Oct. 1969).

Translated from Astron. Zh., 46: 260-5(Mar.-Apr. 1969).

A model of a discrete radio-source is described, whose spectrum exhibits a break at a frequency of 750 MHz. An arbitrary curvature of the spectrum is obtained in this model. (auth)

51223 RELATION BETWEEN THE DISCRETE RADIO SOURCE W43 AND THE NEUTRAL-HYDROGEN DISTRIBUTION. Ariskin, V. I.; Berulis, I. I.; Sorochenko, R. L. (Lebedev Inst. of Physics, Moscow). Sov. Astron. AJ (Engl. Transl.), 13: 219-22 (Sept.-Oct. 1969).

Translated from Astron. Zh., 46: 278-82(Mar.-Apr. 1969).

Observations with the Lebedev Physics Institute's 22-m radio telescope of the H I line and the continuous spectrum at λ = 21.1 cm and of the 104α excited-hydrogen line in the direction of W43 yield a distance of 10.6 kpc for W43, in good accord with measurements of absorption lines in H I clouds and OH lines. (auth)

51224 ABSOLUTE TEMPERARATURE MEASUREMENTS OF THE COSMIC RADIO EMISSION OF THE SKY IN THE DECIMETER RANGE. Pelyushenko, S. A.; Stankevich, K. S. (Gorky State Univ., USSR). Sov. Astron. AJ (Engl. Transl.), 13: 223-5 (Sept.-Oct. 1969).

Translated from Astron. Zh., 46: 283-5(Mar.-Apr. 1969).

The results of absolute temperature measurements of the radio emission of the sky at wavelengths of 15, 20.9, and 30 cm are reported. The antenna temperature was calibrated against the radiation of black bodies maintained at the temperature of liquid nitrogen and at the ambient air temperature. Atmospheric radiation was eliminated by making measurements at two zenith distances. The temperature of the primordial radiation was found to be $T_{pri} = 2.5 \pm 0.3$°K; the spectral index of the distributed galactic radio emission was $\alpha = 2.85 \pm 0.2$; and the effective temperature of this radiation was 0.3, 0.8, and 2.1°K at 15, 20.9, and 30 cm, respectively, for galactic latitudes higher than 50°. (auth)

51225 ABSORPTION OF RADIO WAVES BY THE INTERSTELLAR MEDIUM AND THE DISTRIBUTION OF COSMIC RADIO EMISSION. Benediktov, E. A.; Efimova, T. V.; Skrebkova, L. A. (Gorky State Univ., USSR). Sov. Astron. AJ (Engl. Transl.), 13: 226-30(Sept.-Oct. 1969).

Translated from Astron. Zh., 46: 286-91(Mar.-Apr. 1969).

Observations of cosmic radio emission, carried out with a stationary antenna at frequencies of 9 and 6 MHz, exhibit a marked drop in the radio intensity in the galactic plane at longitude $l^{II} \approx 100°$, caused by interstellar absorption of radio waves. The theoretical dependence of the radio intensity I on galactic latitude is considered. A comparison of the calculations with experimental $I(b^{II})$ curves obtained at various frequencies demonstrates the need to allow for the nonuniform structure of the layer absorbing the radio waves. (auth)

51226 DERIVATION OF THE ELECTRON ENERGY DISTRIBUTION FROM A SYNCHROTRON-RADIATION SPECTRUM. Molodenskii, M. M. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Sov. Astron. AJ (Engl. Transl.), 13: 231-4(Sept.-Oct. 1969).

Translated from Astron. Zh., 46: 292-6(Mar.-Apr. 1969).

A systematic method is developed for deriving the energy dis-

tribution of electrons from the spectrum of their synchrotron radiation. The method is applicable independent of any assumptions regarding the field in the source. Wallis' method is not applicable to the case of a nonuniform field. As an illustration, electron distributions are given that correspond to a typical radiation spectrum under various assumptions regarding the field. (auth)

51227 SPECTRAL FLUX DENSITIES OF RADIO SOURCES AT 22.25 MHz. I. Roger, R. S.; Costain, C. H.; Lacey, J. D. (Dominion Radio Astrophysical Observatory, Penticton, Can.). Astron. J., 74: 366-72(Apr. 1969).

Flux densities for 200 radio sources were derived from observations with the 22.25-MHz radio telescope at the Dominion Radio Astrophysical Observatory. Ionospheric conditions, the method of calibration, and the reduction procedure are described. The effects of these new measures on the spectral indices of the sources are indicated. (auth)

51228 ACCURATE POSITIONS OF QUASISTELLAR OBJECTS DETERMINED BY THE PLATE OVERLAP METHOD. Lue, Phillip K. (Yale Univ. Observatory, New Haven). Astron. J., 74: 352-3(Apr. 1969).

Optical positions on the FK4 system of quasistellar objects were determined with high precision by plate overlap; the internal accuracy is on the average, about ±0".07. Point and small radio-diameter sources were selected at approximately every two hours of right ascension to serve for the calibration of radio interferometers. (auth)

51229 EXTRAGALACTIC RADIO SOURCES. Bolton, J. G. (Commonwealth Scientific and Industrial Research Organization, Sydney). Astron. J., 74: 131-8(Mar. 1969).

The relationships between the observed and intrinsic parameters of extragalactic radio sources are discussed. Many of the quasistellar objects can be distinguished from radio galaxies by the form of their radio spectra. It is shown that only a small percentage of unidentified sources can be quasistellar objects, most of them must be very luminous radio galaxies. The identification content of sources in catalogs compiled at different frequencies changes with the survey frequency; the fraction of quasistellar objects increases with increasing frequency. (auth)

51230 STRUCTURE AND EVOLUTION OF EXTRAGALACTIC SOURCES. Kellermann, K. I. (National Radio Astronomy Observatory, Green Bank, W. Va.). pp 283-96 of Plasma Instabilities in Astrophysics. Wentzel, Donat G.; Tidman, Derek A. (eds.). New York, Gordon and Breach, Science Publishers, Inc., 1969.

From International Conference on Plasma Instabilities in Astrophysics, Pacific Grove, Calif. See CONF-681042.

Topics covered include structure of radio sources, polarization, spectra (optically thin and optically thick), and variable sources. The Seyfert galaxy NGC 1275 is discussed in some detail. (W.D.M.)

51231 GALACTIC WATER VAPOR EMISSION: FURTHER OBSERVATIONS OF VARIABILITY. Knowles, S. H. (Naval Research Lab., Washington, D. C.); Mayer, C. H.; Sullivan III, W. T.; Cheung, A. C. Science, 166: 221-4(Oct. 10, 1969).

Recent observations of the 1.35-cm line emission of water vapor from galactic sources show short-term variability in the spectra of several sources. Two additional sources, Cygnus 1 and NGC 6334N, were observed, and the spectra of W49 and VY Canis Majoris were measured over a wider range of radial velocity. (auth)

51232 THE COMPLEX GALACTIC RADIO SOURCE W51. Terzian, Yervant; Balick, Bruce (Cornell Univ., Ithaca, N. Y.). Astron. J., 74: 76-81(Feb. 1969).

Radio observations of the complex galactic radio source W51 are presented at 195, 430, and 611 MHz. The structure of W51 and the radiospectra of the resolved components are discussed combining the low-frequency observations with existing high-frequency data. It is found that the northern part of W51 consists of two major thermal sources (A1 and A2), and the southern part of at least four components (B1, B2, B3, and B4), one of which is probably a nonthermal source (B2), and the rest being thermal sources. Physical parameters of the various thermal component sources are derived assuming spherical models. The most prominent thermal component (A1) in the northern region of W51 has a mean density of 500 cm^{-3}, and a mass of 2500 solar masses. It is shown that at least 54 O5-type stars are needed to maintain the ionization of bright thermal component A1. (auth)

51233 STUDY OF Hα/[NII] RATIO IN DIFFUSE NEBULAE. Courtes, G.; Louise, R.; Monnet, G. (Observatoire, Marseille). Astron. Astrophys., 3: 222-7(Oct. 1969).

The different optical systems used to obtain the Hα/[NII] ratio in H II regions are described and first results on eight of them are given. From the Hα/[NII] ratio and the electron temperature obtained from the line profiles the $N(N^+)/N_e$ abundance ratio is deduced. The Hα/[NII] variations within a nebula and from one nebula to another are discussed. (auth)

51234 OBSERVATIONS OF PLANETARY NEBULAE AT 11 CM AND 6 CM WAVELENGTHS. Ribes, J. C. (Observatoire, Meudon, France). Astron. Astrophys., 3: 156-62(Oct. 1969).

The 200-meter transit radiotelescope at Nançay was used to observe planetary nebulae at 2 wavelengths: 22 were measured at 11 cm and 11 at 6 cm. Six of the nebulae had not been previously detected. The minimum detectable signal was about 0.01 f. u. Comparison is made with other surveys, and the effects of confusion are discussed. The thermicity of the spectra is established in all cases. The interstellar H_β extinction is derived from comparison with optical observations. (auth)

51235 ON THE FORBIDDEN LINE SPECTRA OF QSS. Mathez, G. (Institut d'Astrophysique, Paris). Astron. Astrophys., 3: 127-34(Oct. 1969).

The results of Burbidge et al. (1966) on the forbidden line spectra of QSS and the physical conditions of the emitting regions are reviewed. It is shown that, in these conditions, the ionization degree of an element is a function of the electron temperature only. The cosmological interpretation of the redshifts is adopted and it is shown that this implies very high energy densities in the QSS. The metastable levels population becomes thus a function of three variables: the electron density N_e, the electron temperature T_e, and the radius R of the emitting region. By comparing the intensities of the forbidden lines, one can then derive for each ion the values of N_e and R, T_e being a priori set. A resume of the structure thus obtained for a standard QSS is given. (auth)

51236 HIGHLY DISPERSED PULSAR AND THREE OTHERS. Large, M. I.; Vaughan, A. E.; Wielebinski, R. (Cornell-Sydney Univ. Astronomy Center, Australia). Nature (London), 223: 1249-50(Sept. 20 1969).

Reference is made to four further pulsars discovered at the Molonglo Radio Observatory during a search at 408 MHz. These are designated as MP 0254, MP 1154, MP 1706, and MP 1911. Physical parameters of these four pulsars are listed. MP 1706 and 1911 were found to be weak and erratic when observed at 408 MHz and bandwidth 4 MHz, whereas MP 0254 was reasonably strong. The data indicate that these three pulsars lie nearby, and almost certainly within the irregular layer of ionized material discussed by Mills (Proc. Astrom. Soc. Austrialia 1: 176 (1969)). MP 0254 is at a high galactic latitude in a region where so far no pulsars have been discovered. MP 1154 is weak and highly dispersed, a dispersion measure of 275 ± 35 cm^{-3} pc being obtained; it is the most highly dispersed pulsar known. Comparisons are made with the highly dispersed MP 1240. Distance estimates place MP 1154 at 2.75 kpc. At distances ≳2 kpc the pulsars may lie either in the outer regions of the Sagittarius spiral arm or in the local arm seen at a distance of some 10 kpc. If these pulsars are at a distance of 10 kpc they must be intrinsically powerful sources with pulse energies ~10^2 times that of PSR 0833-45. MP 1154 and 1240 are certainly among the most distant pulsars known. (UK)

51237 ROTATING NEUTRON STARS, PULSARS, AND COSMIC X-RAY SOURCES. Tucker, W. H. (Rice Univ., Houston, Tex.). Nature (London), 223: 1250-2(Sept. 20, 1969).

The relationship between rotating neutron stars, pulsars, and cosmic x-ray sources is discussed. The latter may be divided into at least two classes: those with large angular diameters, such as the Crab Nebula, and those with small angular diameter, such as Sco X-1. It is submitted that a basic model, consisting of a rotating neutron star losing mass in the presence of a large magnetic field, can account for both types of x-ray source. The extended sources represent the case where the energy in the "neutron star wind" is greater than the magnetic energy. The streaming protons and electrons deposit their energy far out into the nebula in a shock transition region. The relativistic electrons responsible for the extended sources of radio, optical, and x-ray emission are produced in the transfer of energy between the protons and electrons in the shock wave and by magnetic pumping in hydromagnetic waves generated by fluctuations in the mass-loss rate. The compact sources represent the other extreme where the magnetic energy dominates, so that no mass loss occurs. The particles are then accelerated and radiate in radiation belts around the neutron star, resulting in a source with small angular diameter. Detailed consideration is given to the x-ray source in the Crab Nebula. This is followed by a consideration of the rotational energy loss rate for seven pulsars for which slowing down times have been measured. It would appear that only NP 0532 and PS

0833 are capable of producing detectable x-ray fluxes at Earth. The case in which the magnetic energy density is much greater than the particle energy density is considered briefly. If relativistic electrons were produced around such an object they would immediately radiate all their energy by the synchrotron process, and such a model is attractive for the compact x-ray sources such as Sco X-1. (UK)

51238 RELATION BETWEEN THE LINEAR POLARISATION AND SPECTRAL INDEX OF QUASARS. Gilbert, J. A. (Univ. of Manchester, Jodrell Bank, Eng.); Conway, R. G.; Kornberg, P. P. Nature (London), 223: 1252(Sept. 201969).

Observations were made of the linear polarisation of 91 radio sources at 610 MHz, using two radio telescopes (250-ft and 125-ft) as an interferometer, in order to discriminate against the partially polarised background radiation of the Galaxy. A striking correlation was found between the degree of linear polarisation at λ49 cm and the spectral index of 23 quasars. The median polarisation of all 91 sources was 1.2%, the value for the 23 quasars was 1.5%, and that for 49 radio galaxies was 1.0%. A plot of percentage polarization against spectral index is shown. No relation was found between polarisation at λ11 cm and spectral index for quasars. The correlation is interpreted as follows: quasars can be divided into two subclasses by spectral index, of which the subclass with spectral index < -0.5 is heavily depolarised at λ49 cm, probably by the Faraday effect; the polarisation of quasars with spectral index > -0.5, on the other hand, is more nearly constant and may even increase with wavelength, up to λ49 cm. The radio variables belong to the second subclass, and may consist of two or more components. (UK)

51239 MODEL OF CYGNUS X-2. Wilson, R. E.; Sofia, S. (Univ. of South Florida, Tampa). Nature (London), 223: 1350-1 (Sept. 27, 1969).

The model described involves a semi-detached binary in which the x rays are generated by matter flowing from a G star through the gravitational balance point in the rotating coordinate system of the binary, and being accreted onto a compact object, as in Sklovsky's model for Sco X1 (Astrophys. J. Letts. 148: L1(1967)). The compact object is a white dwarf, instead of Sklovsky's neutron star. It is concluded that such a model of Cyg X-2 accounts for the presence of broad Balmer absorption lines with "strange" profiles (very broad, but with no wings), for the weakness of the first two Balmer lines, for the presence of excess blue radiation, for the scatter in the radial velocity measurements, for the production of x rays by a mechanism sufficiently efficient to yield 25L., and for the optical brightness fluctuations, and is in fact consistent with all known observational facts. (UK)

51240 ELECTROMAGNETIC SPECTRUM OF NP 0532. Bertotti, B.; Cavaliere, A.; Pacini, F. Nature (London), 223: 1351-2(Sept. 27, 1969).

The discovery of optical and x-ray emission from the Crab Nebula pulsar NP 0532 greatly extends the spectral band to be accounted for by emission mechanisms. A simple radiation mechanism is examined, based on the vectorial acceleration of relativistic electrons with $\gamma = (E/mc^2) \gg 1$, and on the class of models of "intermediate" and "far" magnetospheres around a spinning neutron star. The radiation process is assumed to occur at a distance of the order of, or larger than, the critical radius $R = C/\Omega$, where Ω is the angular rotation frequency of the star. A situation is envisaged where the radiating particles are coherently forced to rotate around the star by the stellar electromagnetic fields and circle around the lines of force of the magnetic field. The possibility that the radiospectrum is associated with the frequency Ω, whilst the optical and x-ray emissions are related to the gyrofrequency ω_c, is discussed. The very high brightness temperature in the radio band shows the presence of coherence effects, possibly caused by the bunching of particles. For optical and x-ray emission incoherent processes are acceptable. The emission scheme explains why strong optical and x-ray emission shows up for NP 0532 and not for other pulsars. (UK)

51241 A HIGH-SENSITIVITY 1415-MHz SURVEY BETWEEN DECLINATIONS OF 0° AND 20° NORTH. Fitch, L. T.; Dixon, R. S.; Kraus, J. D. (Ohio State Univ., Columbus). Astron. J., 74: 612-88(June 1969).

A 1415-MHz continuum survey with the OSU 260 × 70 ft radio telescope was made between declinations of 0 and 20° north. The area surveyed is approximately 4000 square degrees. Results are presented by a number of maps and a list of about 2100 sources above 0.2 flux units. About 1200 of these sources are previously uncatalogued. The number–flux density slope is −1.57 for flux densities from 0.5 to 1.5 flux units. At 0.3 flux units the survey is estimated to have an incremental and total reliability of 90 and 96%, respectively, and an incremental and total completeness of 80 and 93%, respectively. (auth)

51242 OBSERVATIONS OF W49 AT 2800 MHz WITH AN EAST–WEST RESOLUTION OF 1.5'. Hughes, V. A.; Butler, R. (Queen's Univ., Kingston, Ont.). Astron. J., 74: 608-12(June 1969).

High-resolution studies of W49 were carried out at 2800 MHz with a fan beam with E–W resolution of 1.5'. The change in position and shape of the thermal source confirms the presence of at least one compact region, whilst the shape of the nonthermal source is consistent with its having shell structure typical of a supernova remnant. (auth)

51243 X-RAY EMISSIONS FROM SOLAR FLARES AND FROM CELESTIAL SOURCES. Chubb, T. A. (Univ. of Adelaide). Proc. Astron. Soc. Aust., 1: 4-5(Jan. 1967).

Whether the hard x-ray emission during major solar flares is a thermal or nonthermal phenomenon is considered. The spectral distribution of high-energy x-ray photons was measured from a rocket during the early stages of a Class 2+ solar flare showed the photons to have the energy distribution of a thermal plasma. Moreover, the electron temperature of the plasma decreased steadily during the 5 min of data retrieval. As yet there has been no detection of nonthermal solar x rays. Detection of galactic (as opposed to solar) sources shows at least two distinct types, namely a type-1, which is associated with no obvious peculiar visible or radio object, and a type-2 associated with well-known peculiar visible and radio objects of the supernova remnant type. The type-1 x-ray star Sco XR-1 has a thermal type emission similar to that of a 50 million degree optically thin object, and the type 2 x-ray star Tau XR-1 (Crab Nebula) has an x-ray emission that appears to be a direct extension of the Crab Nebula's visible continuum, believed to be produced by synchrotron emission from relativistic electrons. Sco XR-1 has the appearance of an intense corona surrounding a collapsed star. A continuum flux of soft x radiation, probably of extragalactic origin, has been recorded. (BBB)

51244 PULSARS: FLASH STARS. Kleber, Sylvain. Atomes (Paris), 24: 383-4(June 1969). (In French).

The ejection processes proposed for pulsar behavior do not take into account the optical flashes associated with the corresponding optical object, which have been determined at least for the pulsar NP 0532. In this object the optical flashes are superimposable on the radio pulses. Their period is 33.095 msec, width at half height is 1.5 msec; the two signals raise the magnitude from 17.4 to 14.4 and 15.8. Radiation could be of a synchrotron origin, but coherent plasma oscillations are ruled out by these results. Photographic confirmation has been achieved using television cameras at the Lick Observatory, definitively identifying the pulsar as one of the double stars occupying the Crab Nebula center. It is therefore the first neutron star ever observed optically. A model capable of explaining the behavior based on a hot plasma in a magnetic field above 10^8 has been proposed; the star would have two emissive regions symmetrically disposed on the axis of rotation. An hypothesis of the origin, involving a supernova explosion ejecting a neutron star at relativistic speed, has implications for further study because of the x radiation of the entire Universe as a result. (BBB)

51245 SCO XR-1 AS A MEMBER OF THE UPPER SCORPIUS COMPLEX. Eggen, O. J. (Australian National Univ., Canberra). Astrophys. J., 158: L31-4(Oct. 1969).

Three stars that share the proper motion of Sco XR-1, together with Sco XR-1 itself, are probably members of the Scorpius-Centaurus association of young disk stars. The resulting luminosity of Sco XR-1 is near +6 mag. (auth)

51246 A NEW X-RAY SOURCE IN THE CONSTELLATION ARA. Bunner, A. N.; Palmieri, T. M. (Univ. of Wisconsin, Madison). Astrophys. J., 158: L35-6(Oct. 1969).

Two positions of celestial x-ray sources are confirmed, and a new source is reported in the Ara region. The spectrum of the new source is very soft. (auth)

51247 STIMULATED EMISSION OF RECOMBINATION LINES IN H I REGIONS. Dupree, A. K.; Goldberg, Leo (Harvard Coll. Observatory, Cambridge, Mass.). Astrophys. J., 158: L49-53 (Oct. 1969).

Radio-frequency recombination lines arising from ionized atoms in H I regions can have intensities which are greatly strengthened over their equilibrium values as a result of stimulated emission due to a background continuum. It is suggested that the "anomalous" recombination line is formed in this way. In addition, hydrogen and helium recombination lines from H II regions are expected to have components formed in H I clouds. Recombination

lines may also be observable from H I clouds that are in the line of sight to nonthermal continuum sources. Such lines can be used to give a direct measure of the degree of ionization and abundances in the interstellar medium. (auth)

51248 THE PERIOD AND HARD-X-RAY SPECTRUM OF NP 0532 IN 1967. Fishman, G. J.; Harnden, F. R. Jr.; Johnson III, W. N.; Haymes, R. C. (Rice Univ., Houston, Tex.). Astrophys. J., 158: L61-4(Oct. 1969).

The most probable barycentric hard-x-ray period for the Crab Nebula pulsar was 33071784 ± 6 nsec on 1967 June 4.597 U.T., or 16 nsec greater than that computed from the first- and second-order period-slowdown coefficients found in 1969 at radio wavelengths; the difference may be evidence for either a temporal or a spectral dependence of the coefficients. The Nebula-like spectrum $(1.3 \pm 0.3)E^{-1.2\pm0.4}$ keV $(cm^2$ sec keV$)^{-1}$ was detected in the 1967 data at energies between 45 and 200 keV; an extrapolation down to 1 keV fits the soft-x-ray points. At the NP 0532 phasing, the pulsed radiation at 511 keV was less than 7.3×10^{-4} photon cm^{-2} sec^{-1}, and there was less than 5.0×10^{-4} count cm^{-2} sec^{-1} at energies greater than 560 keV. (auth)

51249 POLARIZATION OF PULSATING RADIO SOURCES. Ekers, R. D.; Moffet, A. T. (California Inst. of Tech., Pasadena). Astrophys. J., 158: L1-8(Oct. 1969).

The complete polarization characteristics of a number of pulsating radio sources were determined at 13 cm. Both a stable average and a time-varying component of the polarized radiation were found. A change in the position angle of the linear component during the course of the pulse is a common property; however, the high degree of linear polarization and constant rotation of angle seen for PSR 0833−45 is atypical. (auth)

51250 PHOTOELECTRIC SPECTROPHOTOMETRY OF B264. Oke, J. B. (Carnegie Institution of Washington, D. C. California Inst. of Tech., Pasadena). Astrophys. J., 158: L9-10(Oct. 1969).

The Braccesi object B264, which has been shown to be a member of a cluster of galaxies, is virtually indistinguishable in luminosity and spectral characteristics from the Seyfert of N-type radio galaxy 3C 120. Apart from luminosity, it is also very similar to the quasi-stellar source 3C 323.1. (auth)

51251 RADIO EMISSION OF QUASI-STELLAR OBJECTS. Lang, Kenneth R. (Arecibo Ionospheric Observatory, Puerto Rico); Terzian, Yervant. Astrophys. J., 158: L11-13(Oct. 1969).

Observations at 318 MHz of thirty-eight quasi-stellar objects are reported. Radio emission was detected from twenty-two of them. Previously most of these sources were known to be blue stellar objects with no detectable radio emission. In particular it is noted that the quasi-stellar object B264 has been shown recently to be a member of a cluster of galaxies. (auth)

51252 MASSES OF QUASI-STELLAR SOURCES. Bahcall, John N. (California Inst. of Tech., Pasadena); Salpeter, E. E. Astrophys. J., 158: L15-17(Oct. 1969).

A general procedure for determining the mass of a quasi-stellar object in a cluster of galaxies is described. Data already available allow one to conclude that the mass of B264 is less than 5×10^{13} $M_\odot$. (auth)

51253 OBSERVATIONS OF RADIO SOURCES AT 4.3-mm WAVELENGTH. Hobbs, R. W.; Corbett, H. H.; Santini, N. J. (Naval Research Lab., Washington, D. C.). Astron. J., 74: 824-6(Aug. 1969).

Measurements were made at the positions of 23 radio sources at 4.3-mm wavelength using the 36-ft parabolic antenna of the National Radio Astronomy Observatory. The flux densities of the seven sources that were detected are given relative to Jupiter. (auth)

51254 FLUX DENSITIES OF RADIO SOURCES AT A WAVELENGTH OF 2.8 cm. Doherty, L. H.; MacLeod, J. M.; Purton, C. R. (National Research Council, Ottawa). Astron. J., 74: 827-32(Aug. 1969).

The flux densities of 146 radio sources at a wavelength of 2.82 cm (10.63 GHz) were measured with the 46-m telescope at the Algonquin Radio Observatory. This list of sources includes all extragalactic sources in the 3CR catalog (Bennett 1962) that have angular diameters less than 2.8′ and peak flux densities greater than 0.4×10^{-26} W m^{-2} Hz^{-1} at 2.82 cm. (auth)

51255 DECLINATION MEASUREMENTS OF SELECTED 4C SOURCES USING THE ARECIBO 1000-FT REFLECTOR. Hazard, C. (Cornell-Sydney Univ. Astronomy Center, Ithaca, N. Y. Cornell Univ., Ithaca, N. Y.); Jauncey, D. L.; Gulkis, S.; Backer, D. C.; Niell, A. E.; Sutton, J.; Harris, D. E.; Gundermann, E. J.; Hardebeck, Gundermann. Astron. J., 74: 833-9(Aug. 1969).

The Arecibo 1000-ft radio telescope is being used to measure declinations of sources in the 4C Catalog to an accuracy of 30″. The methods of calibration are described and the results are given for 200 sources. These new declination measurements are compared with the original 4C measurements. (auth)

51256 RADIO OBSERVATIONS OF THE SUPERNOVA REMNANT HB 21. Erkes, Joseph W.; Dickel, John R. (Univ. of Illinois Observatory, Urbana). Astron. J., 74: 840-5(Aug. 1969).

A contour map of the supernova remnant HB 21 was constructed from observations at a frequency of 2695 MHz. The integrated flux density at 2695 MHz is 160 ± 30 flux units. Variations of the spectral index across the remnant were found by combining the map at 2695 MHz with previously published maps made at frequencies of 178, 610.5, and 1430 MHz. The flux-density spectrum appears to be relatively straight in the central and southern parts of the supernova remnant, and has a mean slope of about −0.40. In the northern part of the supernova remnant, the spectrum is curved, with a turnover at about 250 MHz. Several possible interpretations of this spectral feature are discussed. (auth)

51257 DISPERSION MEASURES OF PULSARS. Davidson, Kris; Terzian, Yervant (Cornell-Sydney Univ. Astronomy Center, Ithaca, N. Y.). Astron. J., 74: 849-54(Sept. 1969).

The relation between dispersion measure and distance for pulsars is considered. The nonuniformity of the interstellar medium makes this relation somewhat uncertain. The distribution of pulsars in the Galaxy is examined. It is found that pulsars tend to concentrate in a band from −10 to 0° in galactic latitude. The absence of pulsars from 6 to 25° in galactic latitude is also noted. The dispersion measures of several pulsars are discussed in detail, in particular, that for the Crab Nebula pulsar. (auth)

51258 POLARIMETER FOR CELESTIAL X RAYS. Schnopper, H. W.; Kalata, K. (Massachusetts Inst. of Tech., Cambridge). Astron. J., 74: 854-8(Sept. 1969).

The properties of a polarimeter using reflection at a Bragg angle of 45° are discussed and applied to the design of a rocket payload for determining the polarization of x rays from celestial sources. Small detector areas are accomplished through the use of toroidally bent crystals to focus the x rays. This device will detect polarizations of as small as a few percent from sources such as Sco XR-1 and the Crab Nebula. With slight modifications, this device can also be used to obtain polarization images of x-ray sources, and also to obtain a spectrum of polarization as a function of energy. (auth)

51259 OB STARS NEAR THE SUPERNOVA REMNANT RCW 103 AND THE GALACTIC STRUCTURE IN NORMA. Westerlund, Bengt E. (Univ. of Arizona, Tucson). Astron. J., 74: 882-90(Sept. 1969).

The small emission nebula, RCW 103, is identical with a nonthermal radio source, Parkes 1613−50. It is most likely a remnant of a supernova of type II and a member of an OB association at a distance of 3900 pc. Another group of OB stars is found in the field at a distance of 1800 pc. Interstellar dust causes heavy absorption well within 1 kpc from the Sun, and another strongly absorbing cloud appears at the distance of RCW 103. The available optical and radio data show that at $l^{II} = 332°$ portions of the Sagittarius arm and the Norma arm are seen. The latter contains most of the thermal radio sources in this direction as well as RCW 103 and its OB association. (auth)

51260 QUASARS. Kahn, F. D. (Univ. of Manchester, Eng.). Phys. Bull. (London), 20: 261-4(July 1969).

The discovery of quasars is briefly outlined, and the following topics are discussed: emission spectra, origin of redshift, longitudinal Doppler shift, redshift as a gravitational effect, and absorption spectra. Unanswered questions regarding these objects are considered. (UK)

51261 INSTRUMENTAL ASPECTS OF GAMMA-RAY ASTRONOMY: SERIOUS NEED FOR NEW IDEAS AND DEVELOPMENTS. Kraushaar, W. L. (Univ. of Wisconsin, Madison). Astronaut. Aeronaut., 7: 28-33, 101-3(July 1969).

Present knowledge of γ-ray sources and instrumentation by which such information has been gained are reviewed, and new approaches for detection equipment design proposed. To date, some 30 remote γ-ray sources have been found, and in no case is there yet a good understanding of the physical conditions under which these γ rays are emitted. Radio sources that emit via the synchrotron process should be emitters of high-energy γ rays. Quantitative arguments show that the relative intensities of the radio noise and γ rays from a particular source should give much information about the magnetic field and amount of gas within

that source. Gamma rays from these mechanisms should be most easily detected in the region above 50 MeV. Detection of γ rays of particular energies give unique and revealing data about where and when the parent elements were created. Various types of spark chambers are described. As used for high-energy cosmic γ-ray investigations, the spark chamber has an important advantage, which ensures that it or some similar instrument will be the ultimate tool for measurements of good quality. With a spark chamber a large solid angle can be viewed during one observation, and the spark tracks can be analyzed individually and associated with a γ-ray arrival direction to within about 1°. An alternative scheme for detecting high-energy cosmic γ rays with good angular resolution is currently being developed. In the proposed device, γ rays enter, pass undetected through a plastic anticoincidence counter, and enter a lead converter where electron–positron pairs are produced. The pairs pass through and are detected in a thin scintillation counter and then enter the large volume of low-pressure gas, where, if their velocity is great enough, the electrons emit Cherenkov light. Cherenkov light is focused by the mirror onto an array of photomultiplier tubes. This proposed instrument features relative simplicity, large area, and expected excellent background-rejection properties. Gamma-ray detection via Cherenkov air-shower light scans is also described. (BBB)

51262 POLARIZATION OF VARIABLE RADIO SOURCES AT 8000 MHz. Aller, Hugh Duncan. Ann Arbor, Mich., Univ. of Michigan, 1968. 99p.

Thesis.

The linear polarization of eleven radio sources that exhibit variations in flux density were monitored at 8000 MHz since 1965 with the Univ rsity of Michigan 85-foot reflector equipped with a rotating linearly polarized feed horn. In addition, H II regions and extended nonthermal radio sources were frequently observed to check the stability of the equipment. Five sources exhibited significant changes in polarization: 3C 120, 3C 273, 3C 279, 3C 345, and 3C 454.3; three sources 3C 84, NRAO 150, and 3C 446 possibly have variable polarizations. These results are the first detections of variations of the polarizations of cosmic radio sources with time. (TSS) (Diss. Abstr. Int., B)

Solar Phenomena

Refer also to abstracts 51160, 51221, 51448, and 51993.

51263 (CEA-CONF-1402) HIGH ENERGY ELECTRONS IN SOLAR FLARES. Koechlin, Y.; Raviart, A.; Treguer, L. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires); Bland, C. J.; Antoni, G. Degli; Dilworth, C.; Maccadni, D.; Tanzi, E. G. (Milan Univ. (Italy). Istituto di Scienze Fisiche). [1969]. 15p. (CONF-690814-5). Dep. CFSTI (U. S. Sales Only).

From 11th International Conference on Cosmic Rays, Budapest, Hungary.

An electron detector capable of registering electrons of energy greater than 10 MeV has been in orbit on the ESRO eccentric satellite HEOS A1 (apogee 220,000 km) since December 5, 1968. During this period, an excess of electrons above the undisturbed level has been observed during solar flares. The rise time and decay of these electrons are examined in relation to the flare parameters, for the flares of February 25, and of March 30. (auth)

51264 (CEA-CONF-1403) OBSERVATIONS ON ELECTRONS IN THE ENERGY RANGE 8 TO 300 MeV. Bland, C. J.; Antoni, G. Degli; Dilworth, C.; Maccagni, D.; Tanzi, E. G. (Milan Univ. (Italy). Istituto di Scienze Fisiche); Koechlin, Y.; Raviart, A.; Treguer, L. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). [1969]. 19p. (CONF-690814-3). Dep. CFSTI (U. S. Sales Only).

From 11th International Conference on Cosmic Rays, Budapest, Hungary.

Preliminary results obtained with an electron counter on the HEOS A1 satellite (apogee 220,000 km) are presented. The counter is a combination of a gas Cherenkov counter with a shower-detecting telescope. The results discussed cover: (a) flux and energy spectra during the undisturbed period outside the magnetosphere; (b) time variations over the orbital operational period; and (c) correlations with magnetic disturbances. The relation of these observations to the origin of the electrons is investigated. (auth)

51265 (CEA-CONF-1404) ENERGY SPECTRA AND TIME PROFILE OF PROTONS EMITTED DURING THE SOLAR FLARE OF JUNE 9, 1968. Engelmann, J.; Hautdidier, A.; Koch, L. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). [1969]. 13p. (CONF-690814-4). Dep. CFSTI (U. S. Sales Only).

From 11th International Conference on Cosmic Rays, Budapest, Hungary.

Energy spectra and flux variations with time of protons emitted during the solar flare of June 9, 1968 were studied with the proton spectrometer aboard the IRIS satellite. The detector is a dE/dx semiconductor telescope with a field of view of 0.3 cm^2 sterad. The energy range covered by the instrument is 26 to 400 MeV. Energy and rigidity spectra obtained at various times after the event are presented. Furthermore, the time profile of six energy windows was drawn and its complex structure seems to be explainable by the magnetic characteristics of interplanetary space after the time of the solar flare. (auth)

51266 (CEA-CONF-1405) SIMULTANEOUS SATELLITE AND ROCKET OBSERVATIONS OF THE FEBRUARY 25TH 1969 SOLAR PROTON EVENT. Barouch, E.; Engelmann, J.; Gros, M.; Koch, L.; Masse, P. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). [1969]. 17p. (CONF-690814-2). Dep. CFSTI (U. S. Sales Only).

From 11th International Conference on Cosmic Rays, Budapest, Hungary.

Energy spectra and time dependence of the particle flux following the proton flare of February 25, were measured by detectors aboard aboard IRIS and HEOS and on two rockets fired from Andenes during the mild PCA that followed this event. These measurements permit a study of cosmic-ray propagation in the region of interplanetary space closest to the earth to be carried out in some detail. (auth)

51267 PROBLEM OF THE EXISTENCE OF SHORT-PERIOD PULSATIONS OF THE MAGNETIC FIELD IN THE SOLAR ATMOSPHERE. Brengauz, V. D. (Gorky State Univ., USSR). Sov. Astron. AJ (Engl. Transl.), 13: 283-5(Sept.-Oct. 1969).

Translated from Astron. Zh., 46: 359-62(Mar.-Apr. 1969).

The possibility of the existence of short-period pulsations of the magnetic fields in the solar chromosphere is investigated theoretically. Definite estimates are made and the results obtained are compared with experimental data. A number of effects which could be connected to the pulsations are also considered. (auth)

51268 AN ATTEMPT TO DETECT LINES OF HIGHLY CHARGED IONS AT 5-cm WAVELENGTH FORMED BY DIELECTRONIC RECOMBINATION IN THE SOLAR CORONA. Dravskikh, A. F.; Dravskikh, Z. V. (Central Astronomical Observatory, Pulkovo, USSR). Sov. Astron. AJ (Engl. Transl.), 13: 360-1 (Sept.-Oct. 1969).

Translated from Astron. Zh., 46: 455-6(Mar.-Apr. 1969).

A multichannel radio spectrograph was used in an effort to detect lines of highly charged ions in the 5-cm wavelength range formed through dielectric recombination in the solar corona. A negative result was obtained. (auth)

51269 MECHANISM FOR THE FORMATION OF CHROMOSPHERIC SPICULES. Pikel'ner, S. B. (Shternberg Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.), 13: 259-66(Sept.-Oct. 1969).

Translated from Astron. Zh., 46: 328-36(Mar.-Apr. 1969).

The ascent of spicules in the chromosphere is explained through gas carried along by magnetic fields from lower chromospheric layers. The chromospheric network contains fields of opposing sign, compressed by the convective motions of the supergranulation. At a height of 1000 to 2000 km the magnetic pressure is comparable to the gas pressure and compresses material toward the neutral lines. The condensed gas slides down along the lines of force into the photosphere. The magnetic pressure again condenses the gas, and the process is repeated. Ultimately the transition layer becomes so thin that the field is annihilated by Joule dissipation, and a reclosure of the lines of force takes place. This process is similar to Petschek's mechanism, but the gravitational field is now included. The loops that are formed carry the gas upward. The shape of the magnetic lines of force and the thickness of the layer are computed as functions of temperature, density, and field strength along the axis. The pressure on the axis is related to the field strength outside the spicules. A field of about 10 G is needed to explain the diameter and density of the spicules; this is consistent with a field of 20 to 40 G at the photospheric level of the network. The instability of the neutral layer and fluctuations arising from the granules will break up the layer of compressed gas into a chain of spicules. Chains of this kind surround coarse "mottles." The field in the mottles evidently differs in sign from the field around them. Field variations due to motions in the photosphere are transmitted upward at high velocity, explaining the nearly simultaneous variation in the rate of ascent of a spicule at different heights. The expansion of a spicule along a neutral line could be responsible for the observed internal

macroscopic motions, which sometimes resemble a rotation. The spicules are heated by accelerated waves which do not experience refraction or reflection in the spicules. Stars having strong photospheric motions would be expected to exhibit more powerful phenomena of the spicule type, which could be one explanation for the ejection of material into the upper layers and the difference in the Doppler shifts of absorption and emission lines. (auth)

51270 STRUCTURE OF THE CO LAYER IN THE SOLAR ATMOSPHERE. Kozhenikov, N. I.; Polonskii, V. V. (Shternberg State Astronomical Inst., USSR). Sov. Astron. AJ (Engl. Transl.), 13: 267-8(Sept.-Oct. 1969).
Translated from Astron. Zh., 46: 337-9(Mar.-Apr. 1969).

The observed and computed parameters of CO molecular lines in the spectrum are compared. The authors conclude that the true intensity of the CO lines at the center of the disk exceeds the observed intensity by several times. This indicated a nonuniform distribution of CO molecules in the solar atmosphere. (auth)

51271 FINE STRUCTURE OF THE PRINCIPAL TERM OF Ca XV AND CORONAL LINES. Kononov, E. Ya. (Commission in Spectroscopy, Moscow). Sov. Astron. AJ (Engl. Transl.), 13: 269-70(Sept.-Oct. 1969).
Translated from Astron. Zh., 46: 340-2(Mar.-Apr. 1969).

The Ca XV spectrum in the vacuum-ultraviolet region was obtained in the laboratory. Comparison of the values of splitting of the main term with the wave numbers of the coronal lines confirms the Edlén–Waldmeier identification. (auth)

51272 POSSIBILITY OF ESTIMATING THE MAGNETIC FIELD IN THE SOLAR CORONA FROM THE TEMPORAL BEHAVIOR OF TYPE III RADIO BURSTS. Fomichev, V. V.; Chertok, I. M. (Inst. of Geomagnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Sov. Astron. AJ (Engl. Transl.), 13: 271-4(Sept.-Oct. 1969).
Translated from Astron. Zh., 46: 343-7(Mar.-Apr. 1969).

It may be possible to find the difference Δh between the levels of emitted ordinary and extraordinary waves, and thus the magnetic field intensity in the generation region from the temporal behavior of the basic mode of type-III radio bursts. It is shown in particular that the passage of the leading part of the agent causing the burst through the extraordinary-wave emission level should be accompanied by a discontinuity in the field growth rate. The time elapsed between the discontinuity and the start of the burst corresponds to the field difference Δh required for the calculation. Calculations show that in the frequency range $f < 130$ to 150 MHz the field growth rate increases discontinuously by a factor of 1.5 to 2; this increase can be detected by highly sensitive receivers with high temporal resolution. (auth)

51273 PLASMA OUTFLOW FROM THE SUN WITH VISCOSITY PLAYING A SIGNIFICANT ROLE. Konyukov, M. V. (Lebedev (Inst. of Physics, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 9: 1-6(1969).
Translated from Geomagn. Aeron., 9: 3-9(1969).

The properties of solutions of equations of a stationary spherical model of plasma outflow from the sun are investigated. It is demonstrated that solutions allowing for gradual transition through the speed of sound cannot be used to interpret the observed properties of the "solar wind" because the system of equations used is not equally applicable in the entire region under consideration. (auth)

51274 IONIZATION AND RAY FORMATION IN COMETS. Rahe, Jurgen; Donn, Bertram (Goddard Space Flight Center, Greenbelt, Md.). Astron. J., 74: 256-8(Mar. 1969).

An observational approach was used as a test for theories of the interaction of comets with the solar wind. Attention was directed to the fact that ionization of cometary matter as well as ray formation take place within a few hundred km distance from the "photometric" nucleus. A theory of these observations has to deal simultaneously with both phenomena in a distance from the nucleus that is an order-of-magnitude smaller than generally assumed in theories of the interaction between solar plasma and cometary material. It is emphasized that observed fluctuations and oscillations of the initial outflow of ionized tail material from its source near the nucleus might have an effect on the direction and structure of individual tail rays and the tail axis. (auth)

51275 SOLAR FLARES. Bruzek, Anton (Fraunhofer Institut, Freiburg i. B.). pp 71-90 of Plasma Instabilities in Astrophysics. Wentzel, Donat G.; Tidman, Derek A. (eds.). New York, Gordon and Breach, Science Publishers, Inc., 1969.
From International Conference on Plasma Instabilities in Astrophysics, Pacific Grove, Calif. See CONF-681042.

This paper concentrates on those observations which may provide information on the origin and mechanism of the primary energy supply of solar flares. These observations include: (1) the behavior of the magnetic field before and during the first stage of the flare, (2) the position of the flare, especially at its start, in the magnetic field configuration, (3) the initial evolution of the flare. Details of the later evolution of the flare and flare-associated phenomena that are obviously secondary processes are not discussed. Observations related to the cool Hα flares are mainly considered. (W.D.M.)

51276 OBSERVATION OF AN X-RAY FLARE: SPATIAL DISTRIBUTION AND PHYSICAL PARAMETERS. Vaiana, G. S.; Giacconi, R. (American Science and Engineering, Cambridge, Mass.). pp 91-118 of Plasma Instabilities in Astrophysics. Wentzel, Donat G.; Tidman, Derek A. (eds.). New York, Gordon and Breach, Science Publishers, Inc., 1969.
From International Conference on Plasma Instabilities in Astrophysics, Pacific Grove, Calif. See CONF-681042.

In order to provide a basis for theoretical models, observation of solar flares must provide clues about (a) the physical regime of the active region, (b) the energy storage, (c) the configuration for which an appropriate plasma instability can trigger the release of the energy, and (d) the time sequence of the various events. It is the purpose of this paper to give the present status of the answers to some of these questions. The answers are based on a recent experiment (June 8, 1968) in which an x-ray telescope with a resolution of a few arc seconds were flown on a pointed, stabilized rocket and photographs were obtained while a flare was in progress. (W.D.M.)

51277 RADIO EVIDENCE OF INSTABILITIES AND SHOCK WAVES IN THE SOLAR CORONA. Wild, J. P. (Commonwealth Scientific and Industrial Research Organization, Epping, New South Wales). pp 119-38 of Plasma Instabilities in Astrophysics. Wentzel, Donat G.; Tidman, Derek A. (eds.). New York, Gordon and Breach, Science Publishers, Inc., 1969.
From International Conference on Plasma Instabilities in Astrophysics, Pacific Grove, Calif. See CONF-681042.

Out of the extraordinary complex and intricate pattern of phenomena observed by radio emission from the solar corona it has, in certain cases, been possible to derive simple and essentially unambiguous descriptions of physical behavior inaccessible to other means of observation. The theory of these phenomena and the instabilities that cause them is uncertain or nonexistent. In this paper attention is mainly concentrated on those aspects of the subject in which the physical implications — though not the theory — are already reasonably definite. In addition, some recent and undigested results are presented. (W.D.M.)

51278 MICROSTRUCTURE OF SUNSPOTS. Beckers, Jacques M. (Air Force Cambridge Research Labs., Sunspot, N. Mex.). pp 139-52 of Plasma Instabilities in Astrophysics. Wentzel, Donat G.; Tidman, Derek A. (eds.). New York, Gordon and Breach, Science Publishers, Inc., 1969.
From International Conference on Plasma Instabilities in Astrophysics, Pacific Grove, Calif. See CONF-681042.

The present knowledge of the properties of the smallest details observable in sunspots is summarized. The details, the microstructures, have sizes $\leq$2000 km. There are no apparent structures in sunspots between this size and the gross structures of spots of about 10,000 to 20,000 km. In the penumbra, the microstructure is predominantly the penumbral filamentation. In the umbra it is the umbral dot structure and a feature in the umbral chromosphere. (W.D.M.)

51279 SUNSPOTS AND PHOTOSPHERIC CONVECTION. Weiss, N. O. (Univ. of Cambridge, Eng.). pp 153-69 of Plasma Instabilities in Astrophysics. Wentzel, Donat G.; Tidman, Derek A. (eds.). New York, Gordon and Breach, Science Publishers, Inc., 1969.
From International Conference on Plasma Instabilities in Astrophysics, Pacific Grove, Calif. See CONF-681042.

At the surface of the Sun the prevalent mode of instability is Bénard convection. This convection interacts with magnetic fields that are present, concentrates the flux into ropes and so forms pores and sunspots. An attempt is made to condense the observational and theoretical information into a simplified phenomenological model to which detailed results and specific problems can be related. What is understood, what is not understood, and what seems to be the most significant problems are pointed out. (W.D.M.)

51280 SUN AS A VARIABLE STAR. Albrecht, R.; Maitzen, H. M.; Rakos, K. D. (Univ., Vienna). Astron. Astrophys., 3: 236-42(Oct. 1969).

An attempt is made to relate the magnetic and light variations

of the Sun to similar phenomena taking place on variable stars. (W.D.M.)

51281 NEAR-LIMB SOLAR BRIGHTNESS DISTRIBUTION AT 1216 A AND 1300 A. Blamont, J. E.; Malique, C. (CNRS, Verrieres, France). Astron. Astrophys., 3: 135-46(Oct. 1969). (In French).

Two photometers were placed on board a sounding rocket for the observation of the total solar eclipse of November 12, 1966. Measurements were started at 220 km during the ascent phase, and ended at 123 km during the descending phase for a total time duration of 296 s. The distributions of brightness were determined with a great relative accuracy at the solar limb and into the chromosphere up to an altitude of 12,000 km at the wavelength of 1216 and 1300 Å. The geometrical limb of the solar disk is formed at these wavelengths at the altitude of 2490 km in the chromosphere. An increase of brightness, or bright ring, is found at the limb. At 1216 Å the maximum of brightness is 4600 km from the geometric limb as defined by a simultaneous infrared observation; the bright ring is 10,000 km wide. At 1300 Å the bright ring coincides with the limb defined in the infrared, and is 4300 km wide. (auth)

51282 MOTIONS OF MAGNETIC FIELDS AND UMBRAE WITHIN A SPOT GROUP. Gopasyuk, S. I. (Crimean Astrophysical Observatory, Crimea, USSR); Moreton, G. E. Proc. Astron. Soc. Aust., 1: 8-9(Jan. 1967).

The last large sunspot group of the last cycle, having Central Meridian Passage (CMP) 20.5 September, 1963, was studied by photoheliograms and magnetograms obtained 4 days before and 4 days after CMP at the Crimean Astrophysical Observatory. The magnetograms showed the distribution of both the transverse and longitudinal components of the magnetic field in the activity region. Umbral motions and their relation to the magnetic field were also studied. Six umbrae were well defined, and daily displacements could be detected within an accuracy of 2000 km. The central large umbra of this group showed proper motion of less than 6 m/sec; hence this umbra was considered stationary and the motions of other umbrae were measured relative to this central umbra. The 5 umbrae described trajectories about the central umbra and, with two exceptions, the daily displacements were fairly uniform, amounting to about 30 m/sec for the slowest moving umbra to about 130 m/sec for the fastest. In general, the change in position angle was relatively uniform, amounting to about 10°/day. In contrast, one case showed an extraordinarily large rotation of 40°/day. Comparison of isogauss maps for the distribution of the longitudinal component of the magnetic field showed that some localized regions of strong spot fields also show daily motion, and that the trajectories of such magnetic features correspond in general to the trajectories of their associated umbrae. The structure of the transverse component of the field changed daily, in some cases systematically and mainly determined by the motions of the sunspot umbrae. In certain areas, over periods of days there is no long range diffusion of sunspot magnetic fields, i.e., the magnetic field may be "frozen" into the photospheric material. (BBB)

51283 ABUNDANCES OF IRON AND SOME OTHER ELEMENTS IN THE SUN AND IN METEORITES. Garz, T.; Kock, M.; Richter, J.; Baschek, B.; Holweger, H.; Unsoeld, A. (Univ., Kiel). Nature (London), 223: 1254-5(Sept. 20, 1969).

It is stated that recent measurements of the oscillator strengths (f values) of Fe I lines have led to an increase in the estimated solar abundance of Fe by a factor of ~10, and that this has far-reaching consequences for astrophysics and for the interpretation of meteorite abundances. Previous work in this field is briefly reviewed, and some systematic errors are indicated. It is considered that the problem of forbidden [Fe II] lines in the Fraunhofer spectrum of the Sun should be re-examined; also earlier determinations of f values for Fe II lines, and some results derived from the ionisation ratio Fe II/Fe I in A-type stars, probably require revision. There is general agreement that type-I carbonaceous chondrites are most closely akin to original solar or population I matter because they still contain many volatile substances, and the abundances in these chondrites closely resemble those on the Sun. The relative abundances of iron and nickel in the Sun and meteorites are also discussed, and some data are given for the solar abundances of Mg and Si. The findings of Urey (Quart. J. Roy. Astron. Soc. 8: 23(1967)) are also discussed. With regard to Li, it is concluded that original solar and population I matter had a large Li abundance, but in the Sun and other old stars Li has been partially destroyed by proton bombardment in the deepest parts of the convection zone. Nowhere in meteorites, or in the Sun, have any conspicious variations of the isotope ratio $^6Li/^7Li$ been found, and neither C nor Li testifies to a partial irradiation of matter in an early state of the solar system. (UK)

51284 SOLAR OBSERVATORY OSO-V. Telecommun. J., 36: 154(Apr. 1969).

The Orbiting Solar Observatory, OSO-V, designed to study the Sun and its influence in the interplanetary space near the Earth, was launched on January 22, 1969 from Cape Kennedy. Planned to provide observations from space during most of an 11-yr solar cycle, the OSO program is one of NASA's major efforts in solar physics. The primary objective of OSO-V is to obtain high spectral resolution data (within the 1 to 1250 Å range) from solar experiments pointed toward the Sun. Three of OSO-V's 8 experiments are located on the sail portion of the space craft and are pointed at the Sun. The remaining 5 are located in compartments of a 9-sided rotating wheel section and scan the Sun every 2 sec. The pointed experiments utilize an x-ray spectrometer, an x-ray spectroheliograph to study intensity and variations of the x-ray spectrum in the 3 to 9 Å and 8 to 18 Å regions, and a far-uv spectroheliograph to monitor the far uv in the 1216-Å, 304-Å, 465-Å, 284-Å, 335-Å, and 299-Å regions. The wheel experiments are performed with zodiacal-light telescopes measuring intensity and polarization of the zodiacal light in the blue and visual regions, Lyman α atomic H cell to monitor self-reversal of the solar Lyman α line, solar far-uv monitor, low-energy γ-ray detector for observation of solar and stellar radiation in the 5 to 150 Å region, and x-ray monitor of the solar flux variation from 0.5 to 3 Å, 2 to 8 Å, 8 to 16 Å, and 0.1 to 1.6 Å. (BBB)

51285 ABSOLUTE CALIBRATION METHOD AND TECHNIQUE OF THE DAILY PATROL OF THE SOLAR FLUX DENSITY AT 1470 MHz. Priese, J. (Heinrich-Hertz-Institut, Berlin). Solar Phys., 9: 235-40(Sept. 1969).

In the frequency range from 1 to 2 GHz discrepancies exist between the values of the solar flux density observed at several stations. In order to clarify the situation a new absolute calibration was carried out at 1470 MHz. The equipment used for this purpose consisted of an electromagnetic horn with calculated gain and of a receiver, the temperature scale of which was calibrated by comparison with the noise of a heated absorber. The noise temperatures of the absorber were identified with the mean thermodynamic temperatures of the absorbing material. The calibration procedure of the receiver and the observation method of the Sun's radiation are described. An error analysis is given in detail, including impedance mismatches of the microwave components as well as impedance variations of the heated absorber. A maximum uncertainty of about ±17% is calculated. (auth)

51286 ON POLARIMETRY IN SOLAR ACTIVE REGIONS. I. THE NEW LOCARNO POLARIMETER: OBSERVING PROCEDURES. Wiehr, E. (Univ., Goettingen, Ger.). Solar Phys., 9: 225-34(Sept. 1969).

The miscentering by the Doppler compensator of the Locarno polarimeter is investigated in detail. It is shown that the linear polarization is strongly falsified by this effect which also occurs at the Crimean and Izmiran polarimeters. The new design for the exit slits of the Locarno polarimeter is described. It avoids the ambiguities in the determination of the magnetic field vector that always occur when using two exit slits. A new simple electronic setup avoids most of the difficulties usually involved in eliminating instrumental polarization and compensating intensity fluctuations. The observational techniques for solar polarimetry at the Locarno observatory are described. (auth)

51287 NOTE ON THE SOLAR WIND-INDUCED DRAG ON COMETS. Gonzales, Douglas E. (ESSA Research Labs., Boulder, Colo.). Solar Phys., 9: 205-9(Sept. 1969).

The solar wind-induced drag on magnetically large comets is estimated as follows. As the comet approaches the Sun, solar radiation striking the comet surface generates a surrounding neutral atmosphere which is subsequently ionized. The resulting plasma cloud interacts with the solar wind to produce a comet magnetosphere and associated collision-free shock wave. An approximation to the accompanying drag is obtained using the similarity between the comet magnetosphere and that of the Earth, and is shown to be much less than the mechanical mass loss force. (auth)

51288 FLARE-TIME SUDDEN ENHANCEMENTS OF LOW-FREQUENCY FIELD STRENGTH AND ASSOCIATED METER-WAVE SOLAR RADIO BURSTS. Alurkar, S. K.; Bhonsle, R. V. (Physical Research Lab., Ahmedabad, India). Solar Phys., 9: 198-204(Sept. 1969).

A number of meter-wavelength solar radio bursts of spectral Type-III were observed by means of a solar radio spectroscope (40 to 240 MHz) simultaneously with sudden enhancements of low frequency (164 KHz) field strength (SES's) of Radio Tashkent which are known to take place due to the enhancements of D-layer

ionization caused by flare-time solar x-rays. The association between the solar x-ray flares as detected by the SES's and the Type-III meter-wave solar bursts is discussed. It is found that the association of SES's and meter-wave solar bursts, which implies the ejection of flare-time electrons towards the photosphere as well as corona, is about 72%. (auth)

51289 PERIODIC STRUCTURES IN QUIESCENT PROMINENCES. Nakagawa, Y.; Malville, J. McKim (National Center for Atmospheric Research, Boulder, Colo.). Solar Phys., 9: 102-15(Sept. 1969).

The observed structural periodicities in quiescent prominences and filaments were examined in terms of the instability of a plasma supported by a magnetic field against gravity. It is suggested that the spacing of arch-like structures may be identified with the most unstable wavelength of the interface between the prominence and the supporting magnetic field. The results of analysis further suggest that the observed spacing of periodic structures corresponds to the supporting magnetic field which lies at an angle 90° to 60° with respect to the long axis of the prominence. (auth)

51290 INTERFEROMETRIC INVESTIGATION OF THE RED AND GREEN CORONAL LINES DURING THE TOTAL SOLAR ECLIPSE OF MAY 30, 1965. Delone, A. B.; Makarova, E. A. (Sternberg Astronomical Inst., Moscow). Solar Phys., 9: 116-30(Sept. 1969).

Fabry–Pérot interferometric observations of the corona were carried out. The 6374 Å line shows radial velocities between 10 and 70 km sec^{-1}, both positive and negative. Most profiles of the 6374 Å line are not Gaussian. The widths of the lines indicate unacceptably high temperatures, and thus suggest turbulent velocities, which appear to be of the same order as the line displacement velocities. Arguments are put forward that the corona consists mainly of individual nonturbulent knots with relative velocities similar to the measured ones. (auth)

51291 MAGNETIC FIELDS AND THE STRUCTURE OF THE SOLAR CORONA. I. METHODS OF CALCULATING CORONAL FIELDS. Altschuler, Martin D.; Newkirk, Gordon Jr. (National Center for Atmospheric Research, Boulder, Colo.). Solar Phys., 9: 131-49(Sept. 1969).

Several different mathematical methods are described which use the observed line-of-sight component of the photospheric magnetic field to determine the magnetic field of the solar corona in the current-free (or potential-field) approximation. Discussed are (1) a monopole method, (2) a Legendre polynomial expansion assuming knowledge of the radial photospheric magnetic field, (3) a Legendre polynomial expansion obtained from the line-of-sight photospheric field by a least-mean-square technique, (4) solar-wind simulation by zero-potential surfaces in the corona, (5) corrections for the missing flux due to magnetograph saturation. It is concluded (1) that the field obtained from the monopole method is not consistent with the given magnetic data because of nonlocal effects produced by monopoles on a curved surface, (2) that the field given by a Legendre polynomial (which is fitted to the measured line-of-sight magnetic field) is a rigorous and self-consistent solution with respect to the available data, (3) that it is necessary to correct for the saturation of the magnetograph (at about 80 G) because fields exceeding 80 G provide significant flux to the coronal field, and (4) that a zero-potential surface at 2.5 solar radii can simulate the effect of the solar wind on the coronal magnetic field. (auth)

51292 ROTATION OF THE SOLAR ATMOSPHERE. Weber, E. J. (Kitt Peak National Observatory, Tucson, Ariz.). Solar Phys., 9: 150-9(Sept. 1969).

A model of the solar atmosphere is presented in which the conservation of angular momentum for the two basic states in which the solar gas can be is discussed: namely, either confined by closed field lines or outflowing along open magnetic field lines. It can be shown that the boundary conditions are in general different for these two cases. From this the results are obtained that in the closed configuration the gas can corotate at the solar surface with the magnetic field lines and its angular velocity will then increase with height, whereas for a gas flowing along an open field line the angular velocity will decrease. An exception to the latter case can be found where the open magnetic field lines are strongly nonradial and where the density is a slowly varying function of radius. In such regions the angular velocity may initially increase with height, reach a maximum and then decrease. (auth)

51293 ON THE LOCALIZATION, SIZE, AND STRUCTURE OF THE REGIONS OF THE X-RAY FLARES ON THE SUN. Beigman, I. L.; Grineva, Yu. I.; Mandel'stam, S. L.; Vainstein, L. A.; Zitnik, I. A. (Lebedev Inst. of Physics, Moscow). Solar Phys., 9: 160-5(Sept. 1969).

With the use of x-ray heliographs carried by the satellites Cosmos-166 and Cosmos-230 the height of an x-ray flare was found to be about 20 to 25,000 km. The regions of the x-ray flares possess a filamentary structure which, during the development of the flares, shows spatial changings with speeds up to 10^7 cm/sec. (auth)

51294 UNPOLARIZED IMPULSIVE SOLAR BURSTS OBSERVED AT 7 GHz. Kaufmann, Pierre (Mackenzie Univ., Sao Paulo, Brazil). Solar Phys., 9: 166-72(Sept. 1969).

The occurrence of very faintly polarized, or unpolarized impulsive bursts observed at 7 GHz is discussed. It appears that some of them show a peculiar spectral peak somewhere between 5 GHz and 7 GHz. Possible interpretations are suggested, emphasizing the need to associate to the burst the state of polarization of the S component in which it occurred. (auth)

51295 MAGNETOHYDRODYNAMIC APPROACH FOR INTERPRETING SOLAR POLARIZATION BURSTS AT 7 GHz. Matsuura, O. T. (Mackenzie Univ., Sao Paulo, Brazil). Solar Phys., 9: 173-82(Sept. 1969).

A magnetohydrodynamic (MHD) approach is presented that appears to be comprehensive for the interpretation of the recently discovered microwave solar events, in which only the degree of circular polarization changes, without any increase in the output of the total solar flux. On the basis of this explanation experimental evidence is suggested for Alfvén waves, in relation to the velocity fields in the solar chromosphere. (auth)

51296 CORONAL DENSITIES AND MAGNETIC FIELDS FROM K-CORONAMETER AND TYPE IV RADIO BURST DATA. Bohlin, J. David; Simon, M. (Carnegie Institution of Washington, D. C. California Inst. of Tech., Pasadena). Solar Phys., 9: 183-93 (Sept. 1969).

From K-coronameter data an electron-density profile was obtained above the active region responsible for the Type IV burst observed on September 14, 1966. If the observed frequency cutoff in the burst's spectrum is caused by the Razin effect, then the coronal electron density may be derived from the intensity variation in the burst as it propagates outwards from the Sun. It is shown that the electron-density profiles obtained from K-coronameter data (appropriate to $1.125 < r/R_\odot < 2.0$) and from the radio data ($2.2 < r/R_\odot < 2.5$) form a continuous distribution. It is concluded that the cutoff is due to the Razin effect, and that radiation in the burst is due to relativistic electrons having a steep inverse power-law energy distribution. From the electron-density profile derived from the radio data, it is found that the coronal magnetic field was 0.26 G at $r/R_\odot = 2.2$. (auth)

51297 ON THE ORIGIN OF TYPE II AND IV RADIO SOURCES DURING FLARES OBSERVED BY A RADIOHELIOGRAPH ON 80 MHz. Krivsky, L. (Astronomical Inst., Ondrejov, Czech.). Solar Phys., 9: 194-7(Sept. 1969).

In papers of Wild (1968) and Wild et al. (1968) photographs of the Sun were published, as obtained by a radioheliograph on 80 MHz at Culgoora. These photographs have shown some unexpected results which were tentatively interpreted by the authors. In this paper another attempt is made at interpreting these results, concerning the extent, position, and motions of type-II and -IV radio sources in the course of the development of a flare, based on the model concepts of proton flares published by Krivsky (1968, 1969a, 1969b) and by Krivsky and Makarov (1966). (W.D.M.)

51298 ROSSBY-WAVE DYNAMO FOR THE SUN. II. Gilman, Peter A. (Univ. of Colorado, Boulder). Solar Phys., 9: 3-18(Sept. 1969).

To make the analysis more tractable, the equations of Part I are simplified to apply to two superposed layers of fluid, with horizontal variations in the motion and magnetic field represented by a small number of Fourier harmonics. The resulting set of eighteen ordinary nonlinear differential equations in time for the Fourier amplitudes is integrated numerically. The dynamo action from a typical Rossby-wave motion is analyzed in detail and compared with the solar cycle. The field-reversal process is similar in some respects to that put forth by Babcock. Toroidal fields are dragged up by vertical motions in the Rossby waves to form large-scale vertical fields, whose polarities alternate with longitude roughly like bipolar magnetic regions. Vertical fields of preferentially one polarity are carried toward the pole by the meridional motion in the wave to form an axisymmetric poloidal field. This poloidal field is then stretched out by the differential rotation into a new toroidal field of the opposite sign from the original. The poloidal field changes sign when the toroidal and bipolar region like fields are maximum, and vice versa. For the case studied, the reversal period is too short (~2 years) and the poloidal fields too large (~40 G) for the Sun. Improvements for the model are discussed. (auth)

51299 PHOTOSPHERIC ABUNDANCE OF IRON. Withbroe, George L. (Harvard Coll. Observatory, Cambridge, Mass.). Solar Phys., 9: 19-30(Sept. 1969).

The center-to-limb variation of equivalent widths of 198 Fe I lines in the spectral region 5500 to 7000 Å was studied with five photospheric models. The gf values of Corliss and Warner (1964) were used in the analysis. The photospheric iron abundance was found to vary with excitation potential. This can be explained by a systematic error in the gf values of high excitation lines and an error of 250 to 500 K in the temperature of the arcs used for measuring the gf values. Departures from LTE in the solar Fe I lines are also a possibility. The adopted photospheric abundance of iron, $\log(N_{Fe}/N_H)$ is −5.2. (auth)

51300 COMMENTS ON FORBIDDEN SULPHUR I LINES IN THE SOLAR SPECTRUM. Swensson, J. W. (Univ. of Lund, Sweden. Univ. of Liege). Solar Phys., 9: 31-4(Sept. 1969).

In a recent paper by Swings et al. (1969) in this journal, results were presented of a search in the solar spectrum for the forbidden lines arising in transitions within the ground configuration ($3s^2 3p^4$) of neutral sulfur. Several references were made to the present author's communications on the same subject. It is maintained that some of the information given in these reports was misinterpreted by Swings et al., in such a way as to cast doubt on the validity of the identification given of the Fraunhofer line λ10821.20 with the forbidden transition S I f ($3p^4\ ^3P_2 - 3p^4\ ^1D_2$). (W.D.M)

51301 INTERPRETATION OF VELOCITY FILTERGRAMS. I. THE EFFECTIVE DEPTH OF LINE FORMATION. Parnell, R. L. (Air Force Inst. of Tech., Dayton, Ohio); Beckers, J. M. Solar Phys., 9: 35-8(Sept. 1969).

A numerical experiment is described in which the effect of an assumed velocity distribution in the solar atmosphere on the intensity difference between a blue- and a red-wing filtergram is derived. This results in the effective optical depth at which the velocity is measured. It is shown that this τ_{eff} strongly depends on the assumed velocity distribution. (auth)

51302 INTERPRETATION OF VELOCITY FILTERGRAMS. II. THE VELOCITY AND INTENSITY FIELD OF THE CENTRAL SOLAR DISK. Beckers, J. M. (Air Force Cambridge Research Labs., Sunspot, N. Mex.); Parnell, R. L. Solar Phys., 9: 39-50 (Sept. 1969).

From simultaneous filtergrams obtained in the blue and red wings of a Fraunhofer line the velocity and intensity field at the center of the solar disk were analyzed. Results are as follows: (a) Cross correlation between velocity and intensity is 0.6. It increases somewhat when long wavelengths (>5000 km) are eliminated. (b) An rms velocity and intensity variation of 0.45 km/sec and 3.9%. The velocity power spectrum and the turbulent velocities measured from line widths and curve of growth are consistent with a power distribution $\bar{G}(k)$ of the form $\bar{G}(k) = \bar{G}(0)k^{-1.1}$ where k is the wave number. (auth)

51303 BOUNDARY CONDITIONS ON MODEL SOLAR CHROMOSPHERES. Athay, R. Grant (National Center for Atmospheric Research, Boulder, Colo.). Solar Phys., 9: 51-5(Sept. 1969).

It is shown that the gas pressure in the corona provides a rather stringent boundary condition on model chromospheres and limits the thickness of those regions of the chromosphere in which the temperature is less than 10,000°K to less than or about 2000 km. (auth)

51304 CHROMOSPHERIC OBSERVATIONS AT THE 1962 ECLIPSE. Henze, William Jr. (National Center for Atmospheric Research, Boulder, Colo.). Solar Phys., 9: 56-64(Sept. 1969).

Slitless spectrograms of the chromosphere obtained by an expedition of the High Altitude Observatory, Sacramento Peak Observatory, and National Bureau of Standards at the eclipse of February 4–5, 1962 are discussed. The data considered consist of previously published line intensities plus continuum data presented here for the first time. The data reduction procedure is briefly reviewed and a source of error introduced during the reduction is described. The error can possibly affect many of the reported line intensities. Comparison of the 1962 observations with the HAO data from the 1952 eclipse indicates that the previously suggested factor-of-two decrease in the earlier data should be modified to a wavelength-dependent correction: a decrease by a factor of three or four at the high Balmer lines, a decrease by a factor of two at λ4700 A, no change at Hα, and an increase by a factor of about 1.5 at the Paschen lines. The observed Balmer-to-Paschen line intensity ratios are therefore in the theoretically acceptable range, in contrast to the 1952 results. The height gradients of the Balmer line intensities agree reasonably well although the 1962 data tend to curve downward relative to a simple exponential distribution. (auth)

51305 ANALYSIS OF THE CHROMOSPHERIC HYDROGEN SPECTRUM AT THE 1962 ECLIPSE. Henze, William Jr. (National Center for Atmospheric Research, Boulder, Colo.). Solar Phys., 9: 65-76(Sept. 1969).

Slitless spectrograms of the chromosphere obtained during the eclipse of February 4–5, 1962 were analyzed to obtain the decrements of the level populations of hydrogen, the self-absorption in the Balmer lines, and parameters useful in construction of models of the low chromosphere. The decrement of the high-energy levels of hydrogen inferred under the optically thin assumption does not vary significantly with height, and it appears to be unnecessary to seek large deviations from local thermodynamic equilibrium in the high levels. The observed Balmer-to-Paschen line intensity ratios were used to infer self-absorption and opacities in the Balmer lines. The resulting population of the second energy level is about an order of magnitude smaller than that found by Athay and Thomas from the 1952 data. The chromospheric continuum was generally underexposed; the absence of observed continuum in the visible region of the spectrum made it impossible to derive a unique model from the 1962 data alone. However, the high Balmer line data and new theoretical solutions of the statistical equilibrium equations for hydrogen combined with corrected 1952 observations at λ4700 A are compatible with a model having approximately the same temperature and neutral hydrogen structure as the 1952 model by Pottasch and Thomas but half the electron density: $T_e = 6200$ K, $N_1 = 7.4 \times 10^{13}$ cm^{-3}, $N_e = 2.3 \times 10^{11}$ cm^{-3} at 500 km and $T_e = 7200$ K, $N_1 = 2.6 \times 10^{12}$ cm^{-3}, $N_e = 1.7 \times 10^{11}$ cm^{-3} at 1000 km. (auth)

51306 INTERPRETATION OF XUV SPECTROHELIOGRAMS. Zirin, Harold (Carnegie Institution of Washington, D. C. California Inst. of Tech., Pasadena). Solar Phys., 9: 77-87(Sept. 1969).

Some parameters of chromospheric structure are drawn from recently published xuv spectroheliograms. The He II emission above the limb arises from the small amount of He^+ still existing at $10^{5\circ}$. The larger amounts of He^+ in the cooler corona at the poles explain the polar cap absorption in λ304. The flat distribution of emission in O IV and O V, with a sharp spike at the limb, is caused by the rough structure of the chromosphere and the variable excitation in the emitting spicules. The intensity of the Ne VII lines shows that the transition zone between chromosphere and corona is very sharp. (auth)

51307 CHROMOSPHERIC VELOCITY FIELD IN SUNSPOT REGIONS. Haugen, E. (Univ. of Oslo). Solar Phys., 9: 88-101 (Sept. 1969).

The wavelength shifts of approximately 8000 absorption elements in the Hα line from spectra of 66 different sunspot regions were measured. The average velocity field in the chromosphere close to sunspots was determined. Inside 15,000 km from the spot's penumbral rim the average velocity vector is directed towards the spot and downwards in the chromosphere; the angle with the horizontal direction is on the average equal to 20°. The magnitude of the average velocity vector shows a maximum of 6.8 ± 1.2 km/sec just outside the penumbral rim and decreases quickly with increasing distance from the spot. Outside 15,000 km from the penumbral rim the average velocity vector is small (≈0.7 km/sec) and directed nearly vertically outwards from the Sun. No significant tangential component of the average velocity field is found. The deviations of the individual elements from the average velocity field are on the average larger than the value of the average velocity. The total rms deviation in the line of sight velocity is equal to 6.8 km/sec. Thus, a large number of elements, as used in this investigation, is required to give significant values of the average velocity vector. Velocities were also observed in the penumbra. The average velocity vector here is probably small and its direction uncertain. The rms deviation in the line of sight velocities observed in the penumbra is equal to 7.5 km/sec. (auth)

Galaxies

Refer also to abstract 51212.

51308 COMPUTER MODEL OF DISKS OF STARS. Hohl, Frank; Hockney, R. W. (Langley Research Center, Hampton, Va.). J. Comput. Phys., 4: 306-24(Oct. 1969).

A computer model for isolated disks of stars is described. The evolution of disks of stars is investigated by following the self-consistent motion of large numbers of point masses as they move in the plane of the disk. Two methods for obtaining the gravitational potential are used. In one method the gravitational potential is obtained by summing directly the 1/r contribution from groups of stars and in the other method Fourier transform techniques are used. The behavior of the model has been compared for the two

methods by studying the results for the particular case of an initially balanced uniformly rotating disk. Such a system is unstable and breaks up into a number of subsystems during the first rotation. The effect of varying the discretization parameters has been studied. The maximum mesh size used was 128 × 128 and the largest number of stars used was 200,000. (auth)

51309 OPTICAL VARIABILITY OF THE NUCLEUS OF THE SEYFERT GALAXY NGC 4151. Zaitseva, G. V.; Lyutyi, V. M. (Shternberg Astronomical Inst., USSR). Sov. Astron. AJ (Engl. Transl.), 13: 184-6(Sept.-Oct. 1969).

Translated from Astron. Zh., 46: 237-9(Mar.-Apr. 1969).

The results of photoelectric photometry of NGC 4151 in the UBV system are reported. The data are compared with observations by other authors. (auth)

51310 THE UBV PHOTOMETRY OF THE SEYFERT GALAXIES. Dibai, E. A.; Zaitseva, G. V.; Lyutyi, V. M. (Shternberg Astronomical Inst., USSR). Sov. Astron. AJ (Engl. Transl.), 13: 187-91(Sept.-Oct. 1969).

Translated from Astron. Zh., 46: 240-4(Mar.-Apr. 1969).

The results are reported for photoelectric observations of the Seyfert galaxies NGC 1068, 1275, 3227, 3516, 4051, 4151, 5548, and 7469 with the 125- and 48-cm reflectors of the Shternberg Astronomical Institute's Crimean Station. Graphs for the variation of brightness and color along the radius of each galaxy are derived from measurements made with concentric diaphragms. (auth)

51311 COMPARISON BETWEEN THE MASSES OF GALAXIES DETERMINED BY OPTICAL AND RADIO METHODS. Vorontsov-Vel'yaminov, B. A. (Shternberg Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.), 13: 235-40(Sept.-Oct. 1969).

Translated from Astron. Zh., 46: 297-303(Mar.-Apr. 1969).

The radius of the turning point on the rotation curve of a galaxy, as estimated by optical methods, is shown to be several times smaller, statistically, than on curves derived by radio observations. The radio curves are evidently more reliable, and furthermore extend much farther out from the center; they should therefore be given preference. Local deviations from circular motion apparently are sometimes adopted as a turning point on curves derived optically, and the galaxy masses computed from such curves are then underestimated. In computing the masses of galaxies smaller than the antenna beam the value $0.73r_H$ should be adopted for the radius of the turning point or the point of maximum velocity, where r_H is the major semiaxis given in Holmberg's photometric catalog. In most cases this assumption will introduce an error of no more than a factor of two. Well-defined spiral arms ordinarily fall within the region of solid-body rotation. (auth)

51312 ELASTIC AND INELASTIC EVOLUTION OF CONCENTRATED GRAVITATING SYSTEMS. I. Gurevich, L. E. (Inst. of Tech. Physics, Moscow). Sov. Astron. AJ (Engl. Transl.), 13: 241-8(Sept.-Oct. 1969).

Translated from Astron. Zh., 46: 304-14(Mar.-Apr. 1969).

A discussion is given of the diffusion of stars in energy space, leading to evaporation of the stars from their system. The rate of evaporation is estimated and agrees roughly with Ambartsumyan's and Spitzer's estimates. For two fairly realistic models the main contribution to the evaporation is shown to come from stars in the outer part of the system, where statistical equilibrium prevails. The size of the stellar halo is estimated, and it is shown that the moment of inertia of the whole system increases during the evaporation process. Evaporation from rotating systems is studied; the flattening of slowly rotating systems will decrease and the system will become increasingly spherical. There will be a slight increase in the angular rotational velocity of a slowly rotating system. (auth)

51313 A MECHANISM FOR GENERATING A SCHWARZSCHILD STELLAR VELOCITY DISTRIBUTION. Genkin, I. L. (Astrophysical Inst., Alma-Ata, USSR). Sov. Astron. AJ (Engl. Transl.), 13: 249-51(Sept.-Oct. 1969).

Translated from Astron. Zh., 46: 315-18(Mar.-Apr. 1969).

The Chapman–Enskog theory is applied in an effort to explain the observed form of the stellar velocity distribution function. This theory implies that the departures from a Maxwellian distribution function in stage III of Agekyan's evolutionary sequence arise from the presence of very small but nevertheless macroscopic motions in the system (a negative K effect). These motions in turn result from the departure of high-velocity stars from the system. Quantitative estimates of the effects in question are made; for appropriate characteristic times the combined action of regular and irregular forces could be responsible for the observed properties of the distribution function. (auth)

51314 THE SPIRAL STRUCTURE OF GALAXIES. I. Marochnik, L. S.; Suchkov, A. A. (Astrophysics Inst., Dushanbe, USSR). Sov. Astron. AJ (Engl. Transl.), 13: 252-8(Sept.-Oct. 1969).

Translated from Astron. Zh., 46: 319-27(Mar.-Apr. 1969).

With the concept of collective interactions as a basis, spiral density waves are discussed in a model galaxy comprising differentially rotating and nonrotating subsystems, corresponding to Populations I and II in normal spiral galaxies. Because of the specific Landau instability for such a system, a steady state can be established through nonlinear effects, with the excitation of finite-amplitude spiral waves. A hypothesis is developed in which these waves would be identified with the spiral structure of galaxies. The present paper contains a linear theory for density waves, while Paper II will give the nonlinear theory and some astronomical implications. In this paper it is shown that in an infinitely thin self-gravitating disk, winding and unwinding (trailing and leading) spiral waves can grow with the same increment. A growing spiral wave will rotate more slowly than the flat (Population I) system. One or several spiral harmonics will remain asymptotically in time from an arbitrary perturbation. Each subsystem will form its "own" spiral arms. In addition to Landau instability, gravitational Jeans instability is possible but it apparently could not be responsible for the formation of the spiral structure. The character of the Jeans instability differs in principle for a single-component system and the multicomponent systems considered here. The same set of problems are examined for a cylinder homogeneous along its rotation axis. (auth)

51315 PARTICLE ACCELERATION IN ASTROPHYSICS. Wentzel, Donat G. (Univ. of Maryland, College Park). pp 271-81 of Plasma Instabilities in Astrophysics. Wentzel, Donat G.; Tidman, Derek A. (eds.). New York, Gordon and Breach, Science Publishers, Inc., 1969.

From International Conference on Plasma Instabilities in Astrophysics, Pacific Grove, Calif. See CONF-681042.

Situations where relativistic electron acceleration appears to be continuous and where enough is known of the needed plasma parameters to permit a meaningful theoretical study are considered. Topics covered include the Crab Nebula, the universal energy spectrum, low-energy cosmic rays, and plasma modes. (W.D.M.)

51316 EXPLOSIONS IN GALAXIES AND QUASARS. Sturrock, P. A. (Stanford Univ., Calif.). pp 297-328 of Plasma Instabilities in Astrophysics. Wentzel, Donat G.; Tidman, Derek A. (eds.). New York, Gordon and Breach, Science Publishers, Inc., 1969.

From International Conference on Plasma Instabilities in Astrophysics, Pacific Grove, Calif. See CONF-681042.

It has been recognized for some time that explosions occur in "active" galaxies, such as radio galaxies, and in quasars. The mechanism of these explosions are considered. The galaxy M87 and the quasar 3C 273 are discussed in detail. (W.D.M.)

51317 THREE-COLOR PHOTOMETRY OF SOUTHERN QSO's, RADIO GALAXIES, AND NORMAL GALAXIES. Westerlund, B. E. (Univ. of Arizona, Tucson); Wall, J. V. Astron. J., 74: 335-51(Apr. 1969).

Data on the UBV system are presented for 14 quasi-stellar radio sources, eight N galaxies, 39 radio galaxies, and 19 radio-quiet galaxies south of +20° declination. Their positions in the two-color diagram show that the integrated colors of the radio galaxies are similar to those of the radio-quiet galaxies of the same morphological type. In an absolute radio magnitude–radio index diagram, a linear relation exists between M_{158} and $(m_{158} - B)_0$ for radio galaxies of all classes. The QSO's however, do not follow this relation, and possible explanations are considered. The brightness and color distributions in the larger galaxies are described in detail. The results are combined with other data for a discussion of the compositions of these systems. It is suggested that a fairly high amount of reddening occurs in the central regions of several galaxies, as for instance, in NGC 1068 and NGC 1316. (auth)

51318 MULTICOLOR PHOTOELECTRIC PHOTOMETRY OF BRIGHT GALAXIES. III. Tifft, William Grant (Lowell Observatory, Flagstaff, Ariz.). Astron. J., 74: 354-65(Apr. 1969).

Four-color photoelectric data on 64 galaxies are presented and discussed; most of the galaxies lie in the region of the Virgo Cluster. Galaxies are divided into groups according to their photometric properties in the nuclear regions. Abnormally red and blue nuclei are found in both spiral and elliptical galaxies. Interstellar reddening and nuclear star formation appear to be involved. A strong concentration of nuclear anomalies is found in the core of the Virgo Cluster. Ultraviolet color variability is considered likely in the nucleus of M87. Color–magnitude dia-

grams for the two brightest magnitudes in the Virgo Cluster are presented and show a well-defined color–luminosity effect. (auth)

51319 TWO-COLOR COMPOSITE PHOTOGRAPHS OF THE MAGELLANIC CLOUDS. Walker, Merle F. (Univ. of California, Santa Cruz); Blanco, Victor M.; Kunkel, William E. Astron. J., 74: 44-6(Feb. 1969).

Composite photographs of the Large and Small Magellanic Clouds prepared from negatives taken in blue and infrared light are presented. The photographs reveal striking differences between the two Clouds. In the LMC, there is a strong concentration of red giant stars of $M_v \geq -3$ in the bar. Outside the bar, the number of these stars is much smaller. Apparently, the earliest generations of star formation occurred in the bar, while at present star formation occurs with about equal frequency in the bar and in the outer parts of the system. The red supergiants of Population I are clustered around the clusters and associations of O and B stars. In the SMC, there are relatively few red giants of the sort found in the LMC, and they share the same surface distribution as the blue stars of Population I. The red supergiants are likewise uniformly distributed, occupying the same area as the blue stars. These differences suggest that in the SMC there was no preferential location for the earliest generations of star formation, that star formation is at this moment less prevalent than recently, that very little star formation occurred until perhaps 10^8 yr ago, and/or that the metal content of the SMC is and has been relatively high. (auth)

51320 CORRELATION OF THE DISTRIBUTIONS OF YOUNG STARS AND NEUTRAL HYDROGEN IN THE SMALL MAGELLANIC CLOUD. Sanduleak, N. (Case Western Reserve Univ., Cleveland). Astron. J., 74: 47-9(Feb. 1969).

A correlation was made between the known surface distributions of the brighter member stars and the neutral hydrogen gas in the Small Magellanic Cloud. It was found that the stellar density of extremely young stars is related to the gas density by $\rho_s \sim \rho_g^{1.84 \pm 0.14}$. This result is consistent with that derived for the Milky Way. (auth)

51321 CYANOGEN ADSORPTION IN THE NUCLEI OF GALAXIES. McClure, Robert D. (Kitt Peak National Observatory, Tucson, Ariz.). Astron. J., 74: 50-3(Feb. 1969).

The violet cyanogen-band absorption was measured photoelectrically at various positions along the major axes of several elliptical and spiral galaxies. In all cases, the cyanogen absorption was found to be stronger in the central cores of the galaxies than in the surrounding areas of the nucleus. The most likely explanation is that the stars in the central cores of typical elliptical and spiral galaxies are super metal-rich with respect to the majority of stars in the solar neighborhood. (auth)

51322 A NEW DETERMINATION OF OORT'S CONSTANT A FROM CEPHEIDS. Crampton, David; Fernie, J. D. (Univ. of Toronto). Astron. J., 74: 53-6(Feb. 1969).

Analysis of the currently available data on classical Cepheids results in a value of Oort's constant $A = +12.5 \pm 2$ km/sec/kpc. The solar motion components in the galactic plane are found to be $U_\odot = -8.0$ km/sec and $V_\odot = +14.5$ km/sec. (auth)

51323 THE GALACTIC FORCE LAW K_z. Perry, Charles L. (Kitt Peak National Observatory, Tucson, Ariz. Louisiana State Univ. Observatory, Baton Rouge). Astron. J., 74: 139-65(Mar. 1969).

An investigation of the galactic force law K_z is presented. When the Z motions are a function of the z distance, the derivation of K_z must be made from Boltzmann's equation; Oort's derivation is applicable only when the Z motions are represented by one or more gaussian functions which are independent of z. Radial velocity measurements and photometric observations were made for the A0–A2 stars brighter than 11.0m within 15° of the NGP. The galactic velocity components of the NGP stars were determined from their radial velocities. The computation of the velocity dispersions revealed that the Z motions of the NGP stars may be represented by a single gaussian dispersion of ±18.4 km/sec or by an arbitrary frequency function. The absolute magnitudes of the NGP stars were determined via interference filter photometry. Members of the Hyades and Pleiades clusters plus nearby early A stars with well-determined parallaxes were employed in the calibration of the absolute magnitudes. The resulting space density distribution is shown. The values of K_z, obtained from both derivations, were not consistent with a "well-behaved" galaxy, as the force reaches a maximum at approximately 200 pc above the plane. Inspection of the Z motion and the space density distributions support the existence of two groups of A stars in the z direction. The difficulty encountered in this determination of K_z most probably lies in the space-density distribution, which is distorted either because the A stars are not yet relaxed with their environment, or by the mixture of two populations of A stars at high galactic latitudes. (auth)

51324 DIFFUSE INTERSTELLAR ABSORPTION BANDS AS DUE TO QUADRUPOLE TRANSITIONS ENFORCED BY A MAGNETIC FIELD. Rudkjoebing, Mogens (Univ. of Aarhus, Denmark). Astrophys. Space Sci., 5: 68-70(Sept. 1969).

The diffuse interstellar absorption bands at λ4890 and λ6180 are believed to belong to electric quadrupole transitions enforced by the presence of the interstellar magnetic field. Their intensities relative to the bands at λ4430 and λ4760 and their state of polarization might be used for an investigation of the field. (auth)

51325 REDSHIFT OF THE N-TYPE RADIO GALAXY 3 C 371. Virtanen, Tapani (Univ. of Oulu, Finland). Astrophys. Space Sci., 5: 76-7(Sept. 1969).

A new identification for spectral lines of the N-galaxy 3 C 371 is proposed. The resulting redshift is z = 0.40. (auth)

51326 GRAVITATIONAL INSTABILITY OF THE INTERSTELLAR GAS. Bertotti, Bruno (Univ., Messina, Italy); Cavaliere, Alfonso. Astrophys. Space Sci., 5: 78-91(Sept. 1969).

In the Galaxy, Jeans' critical length for the interstellar gas is appreciably smaller than the critical length for the stars, a necessary condition for the gravitational instability of the former to have a local character. An accurate discussion of the orders of magnitude involved leads to the establishment of a well defined limiting procedure and to simplified equations in which the effect of stars occurs only through the equilibrium, but disappears from the perturbations. The equations are spatially local, but their coefficients are time-dependent, in that they describe the evolution of a small wave packet dragged along by the supersonic gas motion. They have been solved in several interesting cases by the introduction of an effective, time-dependent wave vector, which describes the deformation of a wave profile due to the velocity gradients. The ordinary Jeans' instability is recovered only when the velocity gradient is a skew tensor; otherwise a stabilizing effect is found in accelerated and sheared flows, a destabilizing effect in a decelerated flow. Possible connections of this model with the observed turbulent structure of the interstellar gas are discussed. (auth)

51327 PHOTOELECTRIC STUDIES OF A NEARBY STELLAR RING IN AQUILA. Isserstedt, J. (Ruhr Univ. Bochum, Ger.). Astron. Astrophys., 3: 210-13(Oct. 1969). (In German).

Photoelectric UBV photometry was used to determine the distance of a stellar ring in Aquila. A distance modulus of 6.95m and reddening $E_{B-V} = 0.08$m were obtained, yielding a minor diameter of 7.4 pc. Stars in the range 0.1m < B-V < 0.6m exhibit an uv excess similar to that observed in the very young open cluster NGC 2264. (auth)

51328 COMPARISON OF THE STAR-DENSITIES FOR DISC AND HALO IN THE DIRECTION TO THE GALACTIC POLES BY MEANS OF THE THREE-COLOR-PHOTOMETRY. Fenkart, R. P. (Univ., Basel). Astron. Astrophys., 3: 228-35(Oct. 1969). (In German).

By use of RGU-photometry disc and halo populations in the direction of SA 141 ($b_{II} = -86°$) were separated and their density-gradients were determined in different luminosity intervals. As in earlier halo papers (Becker, 1965; Fenkart, 1967 and 1968) the method is based on the blanketing effect, which causes a displacement of the metal-poor halo-stars in the two-color-diagrams to the upper right. This and the fact that, under the assumption of a homogeneous limitation of the disc for stars of all luminosities, the absolutely brightest stars fall out systematically along the main sequence in the two-color-diagrams as their apparent magnitude diminishes, permit a statistical separation of the populations. Each star is provided with a statistical value of its absolute magnitude which, together with its measured apparent magnitude, yields a statistical value of its true distance-modulus, since no interstellar absorption could be detected in the directions to the galactic poles. If the number of stars of a given population and a given interval in absolute magnitude which fall into consecutive intervals of distance-modulus is divided by the corresponding volumes determined by these intervals of distance-modulus and the size of the star-field, the density-values of this population and this interval in absolute magnitude at the mean distances of these consecutive volumes is obtained. These density-gradients are compared with the ones for SA 57 ($b_{II} = +85°$) which were obtained by reducing the results of an earlier paper (Fenkart, 1967) for the brighter limiting magnitude: G = 17.5 mag of SA 141 in this paper. (auth)

51329 SOFT X-RAY BACKGROUND FLUX. Bunner, A. N.; Coleman, P. C.; Kraushaar, W. L.; McCammon, D.; Palmieri,

T. M.; Shilepsky, A.; Ulmer, M. (Univ. of Wisconsin, Madison). Nature (London), 223: 1222-6(Sept. 20, 1969).

It is stated that measurements of the soft x-ray background flux show good qualitative correlation with 21 cm measurements of columnar hydrogen density, but too little apparent absorption. A portion of the flux may originate in unresolved population II objects, or may be extragalactic. (auth) (UK)

51330 CLASSIFICATION OF THE FORMS AND THE STELLAR CONTENT OF GALAXIES. Morgan, W. W. (Univ. of Chicago); Osterbrock, D. E. Astron. J., 74: 515-24(May 1969).

Three principal categories of giant galaxies are defined in terms of their stellar population: (1) the Orion category (some irregulars), rich in H II regions, giant blue stars, and a high gas density; (2) the Intermediate (giant spirals similar to NGC 5194 and 4321), absorption spectral types of class F, together with a high degree of compositeness; (3) the Amorphous (nuclear regions of centrally condensed spirals like M31, and the entire main bodies of the giant ellipticals), spectral types near K0 in the blue and violet regions — together with giant spectroscopic characteristics. A category of "combination galaxies" is defined in terms of a marked difference between the absorption spectral type of the nuclear region and the main body. The Andromeda Galaxy is a prototype for this group. It is shown that our own Galaxy also belongs to this "Combination" category. It seems probable that the spectrum of the peculiar irregular NGC 5195 is of the weaklined variety. A review is given of the behavior of emission lines in ordinary galaxies, Seyfert galaxies, and strong radio sources. (auth)

51331 A STUDY OF THE SEYFERT GALAXY NGC 4151. Oke, J. B. (California Inst. of Tech., Pasadena); Sargent, Wallace L. W. Proc. Astron. Soc. Aust., 1: 7(Jan. 1967).

In Seyfert galaxies violent activity is occurring in the nucleus, and some properties suggest a relation with quasi-stellar sources. The spectrum consists of strong, often very broad, emission lines superposed on a continuous spectrum which may show no absorption-line features. Two galaxies, NGC 1068 and 1275, are radio galaxies and the latter is variable at radio frequencies. Observations consist of moderately high resolution photographic slit spectra and photoelectric spectrophotometric measures of absolute flux f(v). The narrow-line component of emission lines is discussed under the assumption that all lines arise from the same mass of gas which can be characterized by one electron temperature T_e and electron density N_e. The ratio of [OIII] lines $\lambda 4959 + \lambda 5007$ to $\lambda 4363$ gives $T_e = 2 \times 10^4$°K. Ratios of lines of [OII], [SII], and [ArIV], give $N_e = 5000$ cm^{-3}. Using the strength of Hβ, a distance for the galaxy of 10 mpc, and $T_e = 2 \times 10^4$°K, a total volume of gas $V = 7 \times 10^{57}$ cm^3 is found for $N_e = 5000$ cm^{-3}. The narrow-line emission spectrum is produced by many small clouds or filaments within the nucleus. The total mass of gas is 3×10^4 $M_\odot$. The contribution of bound–free and free–free transitions of hydrogen to the observed continuum was compared. This contribution is very small except in the spectral region below the Balmer limit. After subtracting this contribution the remaining continuum is smooth and featureless and fits a law, $f(v) = \exp(-cv)$. Since there is no sign of absorption features such as the H and K lines of Ca II, it is suggested that the continuum is predominantly nonthermal in character. (BBB)

51332 STRUCTURE OF DWARF ELLIPTICAL GALAXIES OF THE LOCAL GROUP. Hodge, Paul W. (Univ. of Washington, Seattle); Michie, Richard W. Astron. J., 74: 587-96(June 1969).

Two mechanisms are discussed which will lead to a well-mixed star distribution in dwarf galaxies, in spite of their very low star densities. One of them has recently been discussed by Lynden-Bell, and the other arises from energy exchange between stars and star groups during the formation period. Both mechanisms justify the distribution function used for the calculation of models. Comparison of observed surface densities with the theoretical models indicates good agreement for tidally limited stellar systems. It is shown that none of the six dwarf galaxies of the local group has stars in exclusively isotropic orbits, and that elongated orbits are an important dynamical feature. Information is obtained concerning their origin, formation process, distribution about the Galaxy, and present structure. (auth)

51333 THE NEUTRAL HYDROGEN DISTRIBUTION IN THE NEIGHBORHOOD OF THE REGION OF ANOMALOUSLY LOW POLARIZATION AT $l^{II} = 137^0$, $b^{II} = +7^0$. Verschuur, G. L. (National Radio Astronomy Observatory, Green Bank, W. Va.). Astron. J., 74: 597-603(June 1969).

A B2 star has apparently tunneled its way through an interstellar neutral hydrogen cloud by pushing the larger part of the hydrogen aside and ionizing about one percent of it. The ionized component in combination with distorted magnetic fields gives rise to the anomalous depolarization of the background radiation observed in the region. Similar phenomena occurring throughout the galactic plane might produce localized magnetic field distortions and electron density inhomogeneities on a scale of a few tenths of parsecs to a few parsecs. These events may account for the microstructure required to explain depolarization of extragalactic radio sources at low galactic latitudes. (auth)

51334 DETAILED SURVEY OF THE GALACTIC PLANE AT A WAVELENGTH OF 9.26 cm BETWEEN LONGITUDES 32^0 AND 49^0. Hughes, V. A.; Routledge, D. (Queen's Univ., Kingston, Ont.). Astron. J., 74: 604-7(June 1969).

A survey was made of the galactic plane between longitudes 32° and 49° at the wavelength of 9.26 cm, with an angular resolution of 8.9′, using the 46-m telescope of the Algonquin Radio Observatory. The results are presented in the form of a contour map of constant antenna temperature, and individual sources are tabulated. (auth)

51335 VARIABILITY OF THE SEYFERT GALAXY NGC 1275. Selove, David M. (Univ. of Virginia, Charlottesville). Astrophys. J., 158: L19-20(Oct. 1969).

A decrease of 0.5 mag in the light from the galaxy was observed. (auth)

51336 ON THE NUCLEAR REGION OF M82. Solinger, Alan B. (Goddard Space Flight Center, New York). Astrophys. J., 158: L21-4(Oct. 1969).

The position of the hypothetical Seyfert-like nucleus originally proposed to explain the polarization pattern in M82 is calculated anew in a more quantitative manner. To within the errors involved, the resulting coordinates coincide with those of the infrared nucleus recently observed in this galaxy. The observations are discussed and found to support the Thomson-scattering hypothesis. New observations are suggested that may specify the physical conditions in the nuclear region more completely. (auth)

51337 A BLAST-WAVE MODEL FOR THE EXPLOSION IN THE GALAXY M82. Solinger, Alan B. (Goddard Space Flight Center, New York). Astrophys. J., 158: L25-30(Oct. 1969).

It is shown that a blast-wave interpretation of the explosion in M82 provides a quantitative basis for understanding the observed features. Self-similar solutions to the equations of hydrodynamics for an explosion in a medium with a power-law-varying density, together with the hypothesis of a bright optical nucleus, yield a reasonable fit to the polarized intensities observed and allow all parameters except one to be determined. (W.D.M.)

51338 GROUPS AND CLUSTERS OF SOUTHERN GALAXIES. Klemola, A. R. (Univ. Nacional de Cuyo, San Juan, Argentina). Astron. J., 74: 804-6(Aug. 1969).

Descriptions of 44 probable groups and clusters of southern galaxies are given. These results are based upon examination of direct photographs taken with the Yale–Columbia 20-inch double astrograph. (auth)

51339 INTEGRAL PROPERTIES OF SPIRAL AND IRREGULAR GALAXIES. Roberts, Morton S. (National Radio Astronomy Observatory, Green Bank, W. Va.). Astron. J., 74: 859-76 (Sept. 1969).

General properties of, and relations among, a sample of 98 spiral- and irregular-type galaxies are derived and discussed. The sample represents those galaxies for which total mass (91 systems) and/or H I mass (77 systems) are available. Data derived from optical and 21-cm observations are used. Where necessary, optically derived masses have been adjusted to yield a total mass estimate using a model fractional-mass distribution curve. Masses derived from optical and 21-cm measurements are compared and found to be in good agreement, although the latter appear higher in the mean, by a factor of about 2. Because of the different assumptions made in deriving total masses from optical and from 21-cm measurements, it is not known which, if either, approach yields the true total mass. Hydrogen masses, usually derived on the basis of small optical depth in the hydrogen line, are found to be dependent on the inclination of the system, implying an optical depth effect. A statistical correction is derived and applied to the present set of data. The ratios and relations formed from the integral parameters of total mass, hydrogen mass, and absolute photographic luminosity are discussed. The average ratios of hydrogen mass to luminosity and hydrogen mass to total mass vary systematically with galaxy type. Such variation has been found previously from a much smaller sample size. Contrary to previous views, the ratio of total mass to luminosity does not appear to vary significantly with structural type over the range Sa–Ir. The overall average is 7.5. The hydrogen

mass–luminosity, hydrogen mass–total mass, and total mass–luminosity relations for spirals and irregular systems are given. Surface densities of luminosity, hydrogen, and total mass are tabulated, and the variation of the median values of these densities with structural type is shown. (auth)

51340 PROVEN AND PROBABLE MEMBERS IN THE WING OF THE SMALL MAGELLANIC CLOUD. **Sanduleak, N. (Warner and Swasey Observatory, New York. Case Western Reserve Univ., Cleveland. Cerro Tololo Inter-American Observatory, La Serena, Chile). Astron. J., 74: 877-8(Sept. 1969).**

An objective-prism survey of the wing of the Small Magellanic Cloud was made using the Curtis Schmidt telescope on Cerro Tololo in Chile. An ultraviolet-transparent prism was used to photograph spectra of stars as faint as $m_{pg} \sim 13.5$ with a dispersion of 580 Å/mm at Hγ. A total of 47 stars showing definite or suspected high-luminosity spectral characteristics were found in the region of the wing. Of these, nine are known SMC members. Identification charts are provided. (auth)

Cosmology

Refer also to abstract 51656.

51341 NOTE ON A CURIOUS SOLUTION OF EINSTEIN'S FIELD EQUATIONS. **Prasanna, A. R. (Univ. of Poona). Proc. Natl. Inst. Sci. India, Part A, 35: 375-81(May 1969).**

It is shown that Møller's energy–momentum complex vanishes for a well-known Riemannian metric for which $R_{ij} = 0$ and the usual pseudo-energy tensor also vanishes. The space torsion does not vanish for the metric and only two of the fourteen scalar invariants are nonzero. The crucial role of the constant k, which has to be nonzero, is brought out in several contexts. The space–time singularity $1 + kt = 0$ is without an analog in nonrelativistic physics. (auth)

51342 HOMOGENEOUS–ISOTOPIC SCATTERING OF RADIATION FIELDS ON FLUCTUATIONS OF GRAVITATIONAL FIELDS. **Dautcourt, G. Monatsber. Deut. Akad. Wiss. Berlin, 11: 483-95(1969). (In German).**

Homogeneous and isotropic radiation embedded in Minkowski space–time becomes weakly inhomogeneous and anisotropic due to gravitational interactions, if for times $t > 0$ static random gravitational fields are switched on. The gravitational fields are treated in terms of a homogeneous and isotropic random process, the intensity variations are calculated using the general-relativistic equation of radiative transfer. It is seen that the angular as well as the temporal intensity correlations of the fluctuating part of the radiation decrease to zero for photon paths large compared to the gravitational field correlations length, while the spatial correlations follow those of the gravitational field. A provisional application to the cosmic black-body radiation suggests that intensity variations in the 3°K radiation produced by gravitational fields of clusters of galaxies are of the order $\langle \delta T^2 \rangle^{1/2} / \langle T \rangle \approx 10^{-7}$; this neglects cosmological effects which increase the r.m.s. fluctuation level. (auth)

51343 LEAKAGE ELECTRONS FROM NORMAL GALAXIES: THE DIFFUSE COSMIC X-RAY SOURCE. **Brecher, K.; Morrison, P. (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. Lett., 23: 802-6(Oct. 6, 1969).**

Diffuse cosmic x rays arise from Compton collisions between galactic leakage electrons and the 2.7°K thermal background photons in extragalactic space. Assuming that the break seen in the electron spectra within normal galaxies is intrinsic to the cosmic-ray sources, detailed agreement is obtained with the observed x-ray spectral shape and intensity using only parameters obtained from radio observations. This serves to verify most of the properties of the microwave blackbody radiation. (auth)

51344 AN ASYMMETRIC NON-STATIC DEVIATION FROM THE MINKOWSKI METRIC. **Prasanna, A. R.; Dadhich, N. K. (Univ. of Poona). Proc. Nat. Inst. Sci. India, Part A, 35: Suppl. 1, 70-89(Feb. 1969).**

Several gravitational aspects are considered of a metric which implies an asymmetric nonstatic deviation from the Minkowski metric. Solutions of the field equations of gravitational interest are examined. The C tensor of the tetrad formulation of McCrea and Mikhail are calculated. The energy–momentum pseudotensor is considered for the field in question in alternative ways. The equations of geodesics and geodesic deviations are presented with remarks on the stability of a test particle. The Petrov classification is also considered. Geometrical features like coefficients of rotation and groups of permissible motion are studied. Finally, the class of the metric is examined in the sense of a subspace of the flat space and in this connection some new algebraic relations between scalar invariants are obtained. (auth)

51345 FORMATION OF GRAVITATIONALLY BOUND PRIMORDIAL GAS CLOUDS. **Tomita, Kenji (Hiroshima Univ.). Progr. Theor. Phys. (Kyoto), 42: 9-23(July 1969).**

The formation of gravitationally bound systems from primordial gas was studied by means of Tolman's solution for dust-like matter. The critical values of density contrast and its growth rate at an initial epoch are derived, which are necessary for an inhomogeneity to condense into a bound system before the appearance of the oldest stars. The matter distributions in an isolated inhomogeneity and an inhomogeneity included in a larger one (which will be a cluster of gas clouds) are followed with time by assuming simple models for inhomogeneities, and it is shown how the bound region spreads outwards. Moreover, the minimum mass of fragments into which the gas clouds may break up is examined. (auth)

51346 METAGALACTIC ELECTRONS. **Rozental, I.; Shukalov, I. (Moscow Inst. of Engineering and Physics). Sov. Astron. AJ (Engl. Transl.), 13: 210-12(Sept.-Oct. 1969). Translated from Astron. Zh., 46: 266-9(Mar.-Apr. 1969).**

Results of calculations of the interaction of metagalactic electrons with cosmic black-body radiation (microwave radiation in the centimeter wavelength region) are given. The calculations take account of the expansion of the Universe, curvature of space, and x-ray absorption in the metagalaxy. An upper limit to the intensity of metagalactic electrons in different cosmological models is estimated. (auth)

51347 DISTURBANCES APPEARING ON PASSAGE OF A COLLAPSING SPHERE UNDER A SCHWARZSCHILD SPHERE. **Novikov, I. D. (Inst. of Applied Mathematics, Moscow). Zh. Eksp. Teor. Fiz., 57: 949-51(July 1969). (In Russian).**

It is proven that metric disturbances due to collapse of a finite sphere remain small at the sphere surface in the co-moving reference frame when the surface of the sphere passes under a Schwarzschild sphere. (auth)

51348 NONLINEAR DEVELOPMENT OF DISTURBANCES IN AN ONE-DIMENSIONAL WORLD. **Novikov, E. A. (Inst. of Atmospheric Physics, Moscow). Zh. Eksp. Teor. Fiz., 57: 938-40(July 1969). (In Russian).**

An exact solution is obtained for the problem of development of arbitrary density and velocity disturbances in a one-dimensional world. As an example the nonlinear distortion of a sinusoidal perturbation of the initial density is calculated. (auth)

51349 ORIGIN OF THE BACKGROUND X RADIATION. **Longair, M. S. (Cambridge Univ., Eng. Inst. of Physics, Moscow); Syunyaev, R. A. JETP Lett. (USSR) (Engl. Transl.), 10: 38-40 (July 5, 1969). Translated from Zh. Eksp. Teor. Fiz. Pis'ma Redaktsiyu, 10: 56-9(July 5, 1969).**

Observation of the isotropic background x radiation has revealed a number of distinctive singularities in its spectrum. A model is proposed to explain the spectral properties of the background x rays. The model features electron injection by an aggregate of infrared objects. (W.D.M.)

51350 DEVELOPMENT OF THE METAGALAXY. **Laurent, B. E.; Soederholm, L. (Univ. of Stockholm). Astron. Astrophys., 3: 197-205(Oct. 1969).**

The inner motion of an originally thin cloud of finite mass consisting of matter and antimatter is investigated. The general-relativistic system of equations for matter (and antimatter), radiation, and gravitation is treated numerically. In a certain range of the parameters a violent explosion follows the contraction. The outward velocities in the solutions investigated so far do not however exceed 0.4 of the velocity of light. This may be too low to account for the observed Hubble redshift. (auth)

51351 CORIOLIS EFFECTS IN THE EINSTEIN UNIVERSE. **Lausberg, A. (Institut d'Astrophysique, Liege). Astron. Astrophys., 3: 150-5(Oct. 1969).**

In order to study Thirring's problem in a bounded universe, the static spherical Einstein model is perturbed by the rigid-body rotation of a shell with finite thickness. Only Coriolis effects are investigated. It is shown that the dragging effect on the inertial frame at the center of the shell uniformly decreases with the distance, and increases with the thickness of the shell, in such a way that the complete dragging is reached when the shell covers the whole universe. (auth)

51352 RADIO SOURCES OPPOSITE QUASI-STELLAR OBJECTS AND EINSTEIN–FRIEDMAN'S COSMOLOGY. **Audretsch, J.; Dehnen, H. (Univ., Freiburg i. B.). Astron. Astrophys., 3: 252-5(Oct. 1969).**

Assuming Einstein–Friedman's cosmology with vanishing cosmological constant ($\Lambda = 0$) the relations between the two redshifts

of antipodal objects and the characteristic parameters of the Universe are deduced. Comparison with observations yields: 1) in the case of elliptical space the hypothesis of the existence of antipodal objects is not in contradiction to Einstein–Friedman's cosmology ($\Lambda = 0$); 2) at present the direct verification of this hypothesis by means of both redshifts seems to be impossible. (auth)

51353 ORIGINS OF GALAXIES. Omnes, R. (Laboratoire de Physique Theorique et Haute Energies, Orsay, France). Nature (London), 223: 1349-50(Sept. 27, 1969).

It was suggested that, if mesons are bound states of nucleon–antinucleon pairs there might be a spatial separation of matter and antimatter in the black-body radiation above a critical temperature of about 350 MeV, leading to the production of separate condensations of matter and antimatter. The evolution of such condensations during the cooling down of the Universe is discussed, together with consequences for galaxy and quasar formation. Differences between the hadronic and leptonic era and the radiation era are described. When the radiation period ends gravitation becomes important and the annihilation pressure precipitates the gravitational isolation of condensations into galaxies. A galaxy may have a smaller nucleus of antimatter trapped within it during this process, and this forms the basis for the model of quasars. (UK)

51354 CHARGED SHELLS OF IDEAL FLUID AND THE GRAVITATIONAL COLLAPSE. Kuchar, Karel (Charles Univ., Prague). Wiss. Z. Friedrich-Schiller-Univ., Jena, Math.-Naturwiss. Reihe, 17: 185-8(1968).

The remark that the final collapse of a body could possibly be prevented by a relatively small amount of charge is studied theoretically. The model is an infinitely thin spherical shell from homogeneous charged ideal fluid, the particles of which interact by pressures only in the directions tangential to the shell. This shell would represent the hypersurface of discontinuity in the gravitational and electromagnetic fields. A set of boundary conditions for the gravitational and electromagnetic fields on the charged shell is derived. Equations of motion of the shell are then formulated. The boundary conditions are applied to the homogeneous charged spherical shells, and the equations of motion are integrated to yield the law of conservation of energy, which is the initial point for analysis of the equilibrium states and the collapse of the shells. It is concluded that no charge, however high it may be, can stop the gravitational collapse of the shell below the upper Nordstroem radius. (BBB)

51355 MEASURING THE RATE OF NUCLEOSYNTHESIS WITH A GAMMA-RAY DETECTOR. Clayton, Donald D. (Inst. of Theoretical Astronomy, Cambridge, Eng. Rice Univ., Houston, Tex.); Silk, Joseph. Astrophys. J., 158: L43-8(Oct. 1969).

The gamma-ray lines emitted when ^{56}Ni decays to ^{56}Fe are shown to provide a photon flux which is a significant fraction of the diffuse background near 1 MeV. Successful measurement of the line profiles can reveal both the present and past rates of nucleosynthesis in the Universe. (auth)

51356 GENERAL FORM OF THE EINSTEIN EQUATIONS FOR A BIANCHI TYPE IX UNIVERSE. Ryan, Michael P. Jr. (Univ. of Maryland, College Park). J. Math. Phys. (N. Y.), 10: 1724-8(Sept. 1969).

The Einstein equations for a general Bianchi type IX universe are presented in a form suitable for numerical solution. As an example, the complete equations for a cosmology with a pure fluid stress tensor $T_{\mu\nu} = \epsilon u_\mu u_\nu + P(g_{\mu\nu} + u_\mu u_\nu)$ are also given. (auth)

51357 BIANCHI TYPE-I COSMOLOGICAL MODELS. Jacobs, Kenneth Charles. Pasadena, Calif., California Inst. of Tech., 1969. 255p.

Thesis.

A brief review of observations of cosmological interest and a sketch of the "standard" spatially homogeneous and isotropic cosmological models of the Universe that are currently in vogue are given. Following this introduction anisotropic cosmologies and cosmological models of Bianchi Type I are investigated in detail. The primary goal is to understand the consequences of expansion anisotropies in the general relativistic, hot big-bang theory of cosmology. The Einstein field equations with vanishing cosmological constant, and Maxwell's equations, are used to study the temporal evolution of anisotropic Bianchi Type I cosmologies. These cosmologies are spatially homogeneous, but anisotropic; and they have no rotation. Only cosmologies with the "flat," diagonal, Bianchi Type I metric $ds^2 = dt^2 - A^2(t)dx^2 - B^2(t)dy^2 - C^2(t)dz^2$ are considered. (TSS) (Diss. Abstr. Int., B)

51358 RADIOISOTOPES AND THE HISTORY OF NUCLEOSYNTHESIS IN THE GALAXY. Hohenberg, C. M. (Univ. of California, Berkeley). Science, 166: 212-15(Oct. 10, 1969).

Nearly all of the heavier elements seem to have been assembled by successive neutron captures occurring in two distinct processes: the s (slow) process refers to neutron capture at a rate which is slow compared to the intervening beta decay; the r (rapid) process refers to neutron capture at a rate which is rapid compared to the beta process. It is becoming increasingly apparent that simple models for galactic r-process nucleosynthesis are inadequate. Modern astronomical observations, which indicate that the bulk of r-process synthesis may have occurred early in the life of the galaxy, cannot be ignored. Recent data on the fissiogenic xenon in whitlockite from the St. Severin meteorite also place stringent conditions on permissible models for element synthesis. It appears that neither sudden nor continuous models for element-formation are consistent with isotopic data now available. A more complex model is proposed for the synthesis of solar system material in which the r-process is allowed to occur in three distinct modes: a "prompt" synthesis early in the history of the Galaxy, a "continuous" synthesis whereby r-process products are continuously added to the galactic mix, and a "last-minute" synthesis which enriches the solar nebula with r-process material shortly before the formation of the solar system. Calculations based on the present abundances of uranium-235, uranium-238, and thorium-232 and the measured abundances of iodine-129 and plutonium-244 present when meteorites began to retain xenon indicate that the galactic age is between 8.0 and 8.8 billion years, with the initial "prompt" synthesis accounting for 81 to 89% of the total r-process material ever produced, the "last-minute" synthesis contributing between 11 and 13%, and 0 to 8% occurring in the continuous mode. The time interval between the isolation of the solar nebula from the galactic r process and the onset of xenon retention in meteorites lies between 176 and 179 million years. (auth)

Planetary Phenomena

51359 CONSEQUENCES OF VERY SMALL PLANETARY MAGNETIC MOMENTS. McCormac, B. M.; Evans, J. E. (Lockheed Palo Alto Research Lab., Palo Alto, Calif.). Nature (London), 223: 1255(Sept. 20, 1969).

Consideration is given to possible changes in the atmosphere of the Earth and the planets as a result of the decay of the magnetic dipole moment during reversals of the magnetic field. Mariner V observations showed that Venus now has a zero or very near zero dipole moment, so that its atmosphere may show features which can be explained by erosion and modification by the solar wind. Consideration of the erosion of a planetary atmosphere by the solar wind when the dipole moment is near zero suggests that little or no O^+ should be observed for Venus or Mars above the ionosphere, that enhancement of the cosmic radiation on the Earth cannot occur to any extent, and that the solar radiant energy might increase in certain regions of the Earth's atmosphere. Outside the bow shock on the sunward side of the magnetopause the solar wind will rapidly sweep away all ions formed. Inside the magnetosphere there will be no solar-wind erosion. As the strength of a planets magnetic field decreases, the magnetopause moves toward the planets surface, but at present the Earth's magnetopause is well outside its atmosphere. The maximum value of the dipole moment of Venus is two small to keep the solar wind off the planets surface. During a reversal of the Earth's magnetic field the solar wind should compress the Earth's ionosphere to the same atmospheric pressure as for Venus, and the Earth's atmosphere above 100 to 120 km would be above the inner edge of the magnetopause. The ionosphere of Mars should also be compressed to about 50-km altitude. According to the dipole moment reversal curves the dipole moment may be small enough for the solar wind to erode the Earth's atmosphere for about one solar cycle, and the great variability in solar activity from one solar cycle to another means that effects on the Earth's atmosphere may be very different from one reversal to another. An ion loss of the order of 10^{-4} g/cm^2 during the solar cycle is calculated, and most of the O^+ would be effectively removed from the Earth's atmosphere. No significant increase in cosmic radiation would occur. There might be removal of some of the neutral atmosphere, and some possible mechanisms for coupling the solar wind to the neutral atmosphere are discussed. The loss of 10^{-4} g/cm^2 of ions on a solar cycle may significantly alter the penetration and absorption of solar uv radiation, resulting in a modification of the constituents, chemistry, temperature, albedo, scale height and motion of the atmosphere. It may be easier to explain the structure of the atmosphere of Venus if the ions produced above 170 to 200 km are removed by the solar wind. Atomic oxygen below the Venus magnetopause would be photoionised and lost to the solar wind. A similar argument could explain the failure to observe atomic oxygen in the atmosphere of Mars. (UK)

51360 ALPHA-PARTICLE EMISSIVITY OF THE MOON: AN OBSERVED UPPER LIMIT. Yeh, Richard S.; Van Allen, James A. (Univ. of Iowa, Iowa City). Science, 166: 370-2(Oct. 17, 1969).

Measurements made by the Moon-orbiting spacecraft Explorer 35 during 1967–1968 show that it is unlikely that the alpha-particle emissivity of the Moon is greater than 0.064/cm²/sec/ster and exceedingly unlikely that it is greater than 0.128, these values being respectively 0.1 and 0.2 of the provisional estimates made by Kraner et al. in 1966. This result implies that the abundance of uranium-238 in the outer crust (approximately a few meters thick) of the Moon is much less than that typical of the Earth's lithosphere, though it is consistent with the abundance of uranium-238 in terrestrial basalt or in chondritic meteorites. (auth)

Atomic and Molecular Physics

Atomic, Electron, Ion, and Molecular Beams and Their Reactions

Refer also to abstracts 50106, 50107, 50174, and 52098.

51361 (JAERI–1179) CALCULATION OF PRIMARY ENERGY TRANSFER AND EFFECTIVE INACTIVATION CROSS SECTION OF BIOLOGICAL TARGETS FOR HEAVY CHARGED PARTICLES BASED ON MICRODOSE CONCEPT. Numakunai, Takao; Ohtani, Satoru; Kawai, Katsuo; Oda, Nobuo (Japan Atomic Energy Research Inst., Tokai. Tokai Research Establishment). Aug. 1969. 26p. Dep. CFSTI (U. S. Sales Only).

The distribution of primary energy transfer in a small track segment in water (based on the microdose concept) was calculated according to the newly developed method with an IBM-7044 computer for heavy charged particles, which have energies of 4 to 12 MeV/amu and effective charges of 1 to 18, and varying the delta-ray cut-off energy (125, 250, 500, and 1000 eV) and the target size (l/W = 1/1000 to 1/10 in units of 100 A/eV). The distributions of primary energy transfer for all of these cases are presented as the function of l/W. With the results obtained, the ratio of the effective inactivation cross section to the geometrical cross section for biological targets was calculated for heavy charged particles on the basis of T distribution and the one-target model. (auth)

51362 (KFK–994) AN EMPIRICAL METHOD FOR CALCULATION OF ENERGY DISTRIBUTION FOR CHARGED PARTICLES AFTER PASSAGE THROUGH AN ABSORBER. Weddigen, Ch. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Experimentelle Kernphysik). Apr. 1969. 22p. (In German). Dep. CFSTI (U. S. Sales Only).

An empirical method for calculating energy distributions for charged particles after passage through an absorber is given. The method is based on the fact that range distributions are, within a few percent, gaussian shaped and that relative range straggling is practically independent of absorber material. Thus, by using graphs for particle range, differential energy loss, and relative range straggling energy distributions for small up to complete energy losses can be easily calculated. A brief historical review of theoretical and experimental work published on this subject is given. A description of the method is given and the influence of asymmetries in range distributions is discussed. It is shown that the method can be inverted in order to obtain range straggling from experimental results for energy straggling. Finally, formulas are given for correction with respect to experimental sources of error. The influence of reaction losses on energy distributions has not been taken into account. (auth)

51363 RELATIVE TRANSMISSION OF POSITIVE AND NEGATIVE ELECTRONS THROUGH ALUMINUM. Cook, C. Sharp (Naval Radiological Defense Lab., San Francisco). Phys. Rev., 178: 895-6(Feb. 10, 1969).

A paper by P. S. Takhar [Phys. Rev., 157: 257 (1967)] in which it was concluded that the mass absorption coefficient of various materials is lower for positrons than for negatrons is discussed. The fact that Takhar used radioactive sources (^{68}Ga and ^{86}Rb) having complex energy spectra rather than monoenergetic particles and the difficulties associated with this fact are pointed out. It is concluded that, though Takhar's results undoubtedly show the correct trends in the nature of the transmission through various materials, the values given should not be considered necessarily quantitatively accurate. (A.G.W.)

51364 CALCULATION OF DISSIPATED-ENERGY DISTRIBUTION IN THE THEORY OF TRANSPORT OF ELECTRONS IN MATTER. Endovitskii, V. S.; Narkevich, B. Ya.; Konstantinov, I. E. (Moscow Engineering-Physics Inst.). Izv. Vyssh. Ucheb. Zaved., Fiz., No. 3, 13-19(1969). (In Russian).

A method is proposed for calculation of the spatial distribution function of dissipated energy from a point monodirectional source of monoenergetic electrons in an endless homogeneous environment. The distribution is found by means of solution by the moments method of the corresponding kinetic equation, which was formulated in the approximation of continuous slowing down of electrons, with subsequent reduction according to the spatial coordinates of the distribution function for the calculated system of moments. (tr-auth)

51365 STOPPING CROSS SECTIONS OF Li^+ IONS WITH ENERGIES FROM 30 TO 100 keV IN VARIOUS TARGET MATERIALS. Bernhard, F.; Mueller-Jahreis, U.; Rockstroh, G.; Schwabe, S. (Humboldt-Univ., Berlin). Phys. Status Solidi, 35: 285-9(Sept. 1, 1969).

The electronic stopping cross sections for lithium ions in carbon, aluminum, titanium, nickel, and copper are reported. The dependence on energy in the interval from 30 to 100 keV and on the atomic number of the target atoms is investigated. By using some data from other authors, a characteristic dependence of the electronic stopping cross section on the atomic number of the target atoms is found. (auth)

51366 ABSORPTION OF β PARTICLES FROM TRITIUM AND ^{187}Re IN HELIUM AND ALUMINUM. Naldrett, S. N. (Royal Military Coll. of Canada, Kingston, Ont.). Can. J. Chem., 47: 3913-14(Oct. 15, 1969).

The absorption of the β particles from tritium and from ^{187}Re was found to obey an exponential law for a range of about 6 or 7 times the half-thicknesses. In helium, the half-thicknesses of tritium and of ^{187}Re are found to be $0.046^0 \pm 0.000^7$ and $0.039^3 \pm 0.001^2$ mg/cm²; in aluminum they are $0.036^7 \pm 0.000^9$ and $0.033^6 \pm 0.001^3$ mg/cm², respectively. (auth) (Canada)

51367 PRODUCTION OF HIGH ENERGY NEUTRALS BY MEANS OF H_1^-, H_2^+, AND H_3^+ IONS TRANSFORMATION IN A SUPERSONIC LITHIUM STEAM JET. D'yachkov, B. A. Zh. Tekh. Fiz., 38: 1259-72(Aug. 1968). (In Russian).

A supersonic lithium-vapor jet of thickness up to 5×10^{15} at./cm² was used to investigate the charge-exchange properties of lithium. A procedure was developed for determining the thickness of the jet from the heat released upon condensation of the lithium vapor and from the average velocity of the jet. The coefficients of conversion of ions H^-, H_2^+, and H_3^+ with energies 100 to 400 keV into fast neutral atoms (neutrals) were measured. The jet thickness at which the yield of the neutrals reaches a maximum is determined. Measurements were made of the condensation coefficient of lithium on lithium. It is shown that the angular divergence of the neutrals with energy of several hundred keV, produced as a result of dissociation of the ions H_2^+ and H_3^+ in lithium ($\delta = 10^{15}$ at./cm²), is determined by the inelastic collisions of the primary ions with the lithium atoms. It is shown that the high-energy neutrals (hundreds of keV) are easiest to obtain, from the energy point of view, from negative ions. (ATD)

51368 THE DETERMINATION OF ABSORPTION COEFFICIENTS OF BETA PARTICLES FROM ^{140}La, ^{147}Nd, AND ^{59}Fe FOR THE STUDY OF DIFFUSION IN SOLIDS. Filonov, B. O.; Shimanovich, I. E.; Pavlyuchenko, M. M. Dokl. Akad. Nauk BSSR, 13: 414-16(1969). (In Russian).

Backings of different oxides were used to determine the mass absorption coefficients for β particles from the radioactive isotopes ^{140}La, ^{147}Nd, and ^{59}Fe. It was established that the absorption coefficients for each isotope show no significant dependence on the backing material. However, absorption coefficients determined without a reflector (using radioisotopes supported on thin synthetic films) were slightly less than those obtained with a reflector. It was shown that the position of the absorber relative to the radioactive sample has a significant effect on the value of the coefficient. The values obtained vary almost by a factor of two according to whether the absorber is laid directly on the surface of the sample or whether it is under the window of the counter at a distance from the radioactive source. Values obtained using the latter position of the absorber are not recommended for use in the study of diffusion in solids because this position does not correspond to the conditions of diffusion measurements. (tr-auth)

51369 EFFECTIVE ATOMIC NUMBERS FOR PHOTOELECTRIC PROCESS OF GAMMA RAYS IN ALLOYS. Parthasaradhi, K.; Chintalapudi, Surya N.; Sastry, D. L. (Andhra Univ., Waltair, India). Indian J. Pure Appl. Phys., 7: 389-90(June 1969).

The uniqueness of the effective atomic numbers for photoelectric processes in 4 alloys, viz, ordinary bronze, bell metal, white gold,

and solder was tested in the gamma energy region 10 to 412 keV. It was found that the number remains, more or less, constant down to the gamma energy of the K-absorption edge of the highest-atomic-number element involved in each alloy. (auth)

51370 STRUCTURE OF TRANSIENT RADIATION GENERATED BY ELECTRONS DEEP IN POLYMETHYLMETHACRYLATE. Cabak, I. (Palacky Univ., Olomouc, Czech.). Czech. J. Phys., B19: 1290-4(1969).

The photoelectric measurement of the intensity and spatial distribution of transient radiation inside a massive sample of polymethylmethacrylate is described. The radiation is generated by electron beams with kinetic energies in the interval 20 to 80 keV. The polarization, the influence of the component uv, and the action of absorption effects were also investigated. (auth)

Atomic and Molecular Properties

Refer also to abstracts 51627, 51646, 51818, and 51822.

51371 (UCRL-19245) SEARCH FOR AN ELECTRON MASS SHIFT IN ^{133}Cs IN AN INTENSE ELECTROMAGNETIC FIELD. Mowat, J. Richard (California Univ., Berkeley. Lawrence Radiation Lab.). Aug. 15, 1969. Contract W-7405-eng-48. 90p. Dep. CFSTI.

The possibility that the mass of a bound electron changes when placed in an intense electromagnetic field was investigated both theoretically and experimentally. The atomic-beam magnetic-resonance technique was used to examine hyperfine-structure shifts in ^{133}Cs that occur when the atom is subjected to an intense, nonresonant magnetic field perpendicular to the static "C" field. A 2921-MHz TM_{010} cavity was situated between Ramsey separated oscillatory loops, which induced the transitions of interest. Shifts were observed for six $\Delta F = \pm 1$, $\Delta m_F = \pm 1$ transitions at field-independent points. No evidence was found for an electron mass shift. Excellent agreement was found between all observed shifts and those expected from a multilevel Bloch–Siegert effect. Theoretical reasons, based upon perturbation theory, are given for the nonoccurrence of the mass-shift effect in the ground state hyperfine-structure of a hydrogen-like system. (auth)

51372 FIRST IONIZATION POTENTIALS OF Th, Np, AND Pu BY SURFACE IONIZATION. Smith, David H.; Hertel, G. R. (Oak Ridge National Lab., Tenn.). J. Chem. Phys., 51: 3105-7 (Oct. 1, 1969).

The surface ionization comparison technique was used to measure the first ionization potentials of Th, Np, and Pu relative to U. The differences in ionization potentials (ΔI.P.) obtained were: ΔI.P.(U−Th) = −1.29 ± 0.26 eV; ΔI.P.(U−Np) = 0.03 ± 0.01; and ΔI.P.(U−Pu) = 0.48 ± 0.02. The I.P. of U had previously been determined in this laboratory to be 6.19 ± 0.06 eV. Based on this value, the I.P. of Th is 7.5 ± 0.3 eV; Np, 6.16 ± 0.06; and Pu, 5.71 ± 0.06. (auth)

51373 METHOD OF LOCAL CONFIGURATION INTERACTION APPLIED TO ELECTRONIC SYSTEMS. HYDROGEN ATOM AND HYDROGEN MOLECULE ION. Rothstein, Stuart M.; Welsch, James E.; Silverstone, Harris J. (Johns Hopkins Univ., Baltimore). J. Chem. Phys., 51: 2932-6(Oct. 1, 1969).

The local configuration interaction method, a way to solve the Schrödinger equation without evaluating integrals, is applied to two electronic systems: the hydrogen atom and the hydrogen molecule ion. The exact energies are reproduced for both systems. The H_2^+ is treated both as a separable and nonseparable problem. The convergence to the exact energy is seen to be slower than for a variational calculation with the same basis. (auth)

51374 HYPERFINE STRUCTURE OF THE $6s6p^3P_1$ STATE OF ^{171}Yb AND ^{173}Yb. Baumann, M.; Liening, H.; Wandel, G. (Univ., Tuebingen, Ger.). Z. Phys., 221: 245-56(1969). (In German).

The hyperfine structure of the $6s6p^3P_1$ state of ^{171}Yb and ^{173}Yb was investigated by the level-crossing technique and by optical double resonance. The following results for the magnetic hfs splitting constant A and for the electric quadrupole interaction constant B were obtained: A(^{171}Yb) = 3959.1(14) Mc/sec; A(^{173}Yb) = −1094.7(6) Mc/sec; B(^{173}Yb) = −826.9(9) Mc/sec. The hyperfine structure anomaly of the isotopes ^{171}Yb and ^{173}Yb was determined to be $\Delta = -0.36(3)\%$. (auth)

51375 HYPERFINE STRUCTURE INVESTIGATIONS IN Os I AND Eu II AND THE NUCLEAR QUADRUPOLE MOMENTS OF ^{189}Os, ^{151}Eu, AND ^{153}Eu. Guthoehrlein, G.; Himmel, G.; Steudel, A. (Technische Univ., Hanover). J. Phys. (Paris), 30: Colloq. C1, 66-73(Jan. 1969).

From Conference on Atomic Spectroscopy, Caen, France. See CONF-681067.

The hyperfine structure of eleven lines of the arc spectrum of osmium and of four lines of the spark spectrum of europium was investigated. The A and B values of the levels $5\,d^6\,6\,s^2\,{}^5D_2$, $^5D_3$, $^5D_4$ and $5\,d^7\,6\,s\,{}^5F_5$ or linear combinations of these coupling constants were determined for the isotope ^{189}Os. The measured A values were used to check the eigenfunctions of Gluck, Bordarier, Bauche, and van Kleef, which have been calculated for intermediate coupling considering configuration interaction between $d^6\,s^2$, $d^7\,s$ and d^8. The agreement between calculated and observed A values was very satisfactory. The value of the nuclear quadrupole moment derived from the measured B-factors is: $Q(^{189}Os) = (0.91 \pm 0.10) \times 10^{-24}$ cm^2. The A and B values of the levels $4f^7\,6\,p\,z\,{}^9P_3$, $^9P_4$, and $^9P_5$ were evaluated for the isotopes ^{151}Eu and ^{153}Eu. The A values were used to check the eigenfunctions of Bordarier, Judd, and Klapisch, which have been calculated for intermediate coupling. Good agreement between the calculated and observed A values was reached only if the spherical-symmetric part of the magnetic hyperfine interaction operator of the 6 p electron was used as a free parameter. The quadrupole moments derived from the B values using the unperturbed eigenfunctions were $Q(^{151}Eu) = (1.12 \pm 0.07 \times 10^{-24}$ cm^2 and $Q(^{153}Eu) = (2.85 \pm 0.18) \times 10^{-24}$ cm^2. (auth)

51376 ISOTOPE SHIFT IN INFRARED LINES OF Ce I AND Ce II. Champeau, R.-J.; Verges, J. (CNRS, Orsay, France). J. Phys. (Paris), 30: Colloq. C1, 64-5(Jan. 1969). (In French).

From Conference on Atomic Spectroscopy, Caen, France. See CONF-681067.

The isotope shifts of four low-lying event levels of Ce I and of seven low-lying levels of Ce II (3 odd and 4 even) were measured by analyzing 20 infrared lines (15 spark lines and 5 arc lines), using a high resolution SISAM spectrometer. (auth)

51377 INTERPRETATION OF ELECTRONIC CONFIGURATIONS IN ARC SPECTRA OF NEODYMIUM. Wyart, J. F. (Laboratoire Aime Cotton, Orsay, France). J. Phys. (Paris), 30: Colloq. C1, 50(Jan. 1969). (In French).

From Conference on Atomic Spectroscopy, Caen, France. See CONF-681067.

In a recent analysis of the Nd I spectrum by study of the Zeeman effect, ten configurations were determined. Results of parametric calculation for two of them are briefly described. (auth)

51378 LEVEL-CROSSING EXPERIMENTS IN THE Tm I AND Sm I SPECTRA. Hendrich, E.; Steudel, A.; Wallenstein, R.; Walther, H. (Technische Univ., Hanover). J. Phys. (Paris), 30: Colloq. C1, 18-23(Jan. 1969).

From Conference on Atomic Spectroscopy, Caen, France. See CONF-681067.

The lifetimes of 12 levels of the Tm I and of 4 levels of the Sm I spectrum were measured using the technique of zero-field level crossing (Hanle effect). For two Tm I levels the hyperfine splitting of ^{169}Tm was also measured by investigating the level crossings at finite magnetic fields. The lifetimes of the Tm I levels are discussed using the eigenvectors recently derived by Camus. (auth)

51379 CONFERENCE ON ATOMIC SPECTROSCOPY, CAEN, FRANCE, OCTOBER 7–9, 1968. J. Phys. (Paris), 30: Colloq. C1, 1-90(Jan. 1969). (In French and English). (CONF-681067).

Twenty-two papers and abstracts of eight papers presented at the conference are included. Separate abstracts were prepared for six of the papers; the remainder were considered to be outside the scope of NSA. (A.G.W.)

For abstracts of individual papers see: 51375–51378, 51380, and 51381.

51380 LASER LINES IN METALLIC VAPORS. Cahuzac, Ph.; Brochard, J. (Laboratoire Aime Cotton, Orsay, France). J. Phys. (Paris), 30: Colloq. C1, 81-2(Jan. 1969). (In French).

From Conference on Atomic Spectroscopy, Caen, France. See CONF-681067.

Electric pulse excitation was used to observe 28 infrared laser lines in thulium, ytterbium, and samarium vapors. The best results are obtained with 350-A peak current pulses of 2 μsec width. (auth)

51381 UNIFICATION OF THE A AND B SYSTEMS IN THE SPARK SPECTRA OF URANIUM. Blaise, J. (CNRS, Orsay, France). J. Phys. (Paris), 30: Colloq. C1, 74(Jan. 1969). (In French).

From Conference on Atomic Spectroscopy, Caen, France. See CONF-681067.

The A and B systems of U II, based on $5f^4\,7s\,{}^6I_\frac{9}{2}$ and $5f^3\,7s^2\,{}^4I^0_\frac{9}{2}$ respectively, have been connected: the $^6I_\frac{9}{2}$ level lies at 4663.86 K above the ground level $^4I^0_\frac{9}{2}$. (auth)

51382 STUDY OF INFRARED EMISSION SPECTRA USING A SISAM. III. EMISSION SPECTRUM OF SAMARIUM. Blaise, J.; Morillon, C.; Schweighofer, Marie-Gabrielle; Verges, J. (CNRS, Orsay, France). Spectrochim. Acta, 24B: 405-45(Aug. 1969). (In French).

The samarium spectrum emitted by an electrodeless tube was recorded with a SISAM spectrometer in the region from 0.8 to 2.5 μ. The wave numbers of 1812 lines were measured with a precision varying with the intensity between 0.06 and 0.20 cm^{-1}. The Zeeman structure of seven of these lines was measured with another SISAM spectrometer, which had a limit of resolution of 0.027 cm^{-1}. These measurements were completed with the study of Zeeman spectrograms in the visible and the ultraviolet and permitted the classification of 859 infrared lines. At present the number of levels is 447 for Sm I and 325 for Sm II. (auth) (UK)

51383 OPTICAL ISOTOPE SHIFTS AND NUCLEAR DEFORMATION IN DYSPROSIUM. Dekker, J. W. M.; Klinkenberg, P. F. A.; Langkemper, J. F (Univ., Amsterdam). Physica, 39: 393-412(Aug. 26, 1968).

The isotope shift in six Dy I lines was investigated by means of the technique of exchanging light sources containing enriched isotope samples and a recording Fabry–Perot spectrometer with a digital output. The analysis of output data was made by means of an electronic computer. The results prove that the isotope shift is a mixture of mass and field effect, and that the minimum value of the specific mass effect is about 6 times the general mass effect. By assuming this minimum value as the most probable one, the relative field shift is obtained. This is interpreted as a combined volume and quadrupole shift and compared with nuclear data. The results are discussed in connection with the collective model of the nucleus taking account of nuclear deformation. A fairly consistent picture is obtained, both with respect to the irregularities in the relative field shift and the spins and parities of the odd-A nuclei. The values of the nuclear deformation parameter are lower than those known from rotational level structures. Evidence is presented that the transition from the single-particle model to the collective model, usually considered to take place when the 45th pair of neutrons enters, may be slightly Z-dependent so as to occur between N = 90 and N = 92 in dysprosium. (auth)

51384 EXPERIMENTAL DETERMINATION OF RADIATION LIFETIMES AND TRANSITION PROBABILITIES IN Ar I. Verolainen, Ya. F.; Osherovich, A. L. Opt. Spectrosc. (USSR) (Engl. Transl.), 25: 258-9(Sept. 1968).

Translated from Opt. Spektrosk., 25: 466-8(Sept. 1968).

The radiation lifetimes of the $2p_2$, $2p_3$, and $2p_4$ ($3p^54p$ configuration) and the $3p_1$, $3p_3$, $3p_5$, $3p_6$, $3p_7$, and $3p_8$ ($3p^55p$ configuration) levels of Ar I were measured using the delayed-coincidence method and continuous excitation of argon by an electron beam. (M.H.R.)

Positronium, Muonium, and Mesic Atoms and Molecules

Refer also to abstracts 51859 and 51990.

51385 LEVEL SHIFTS IN THE HYPERFINE STRUCTURE OF POSITRONIUM. Urbanovich, S. I. Dokl. Akad. Nauk BSSR, 13: 405-7(1969). (In Russian).

The effect of the internal fields of the medium surrounding an atom of positronium on the character of the wave function of the positronium atom is considered. The Schroedinger equation for a positronium atom in the field of a medium is solved. An analytical expression is obtained for the energy excess of the triplet state over the singlet state in relation to the magnitude of interatomic (intermolecular) interactions. Numerical estimates of the boundaries of regions of manifestation of these properties of positronium are given. The results of a number of experimental works are explained on the basis of these concepts. (tr-auth)

51386 MUONIC-MOLECULE CALCULATIONS BY VARIATION OF FUNCTIONS. Carter, Benjamin P. (Univ. of California, Livermore). J. Comput. Phys., 4: 325-46(Oct. 1969).

The adiabatic method is generalized by a trial function ψ containing products of arbitrary functions, each of which depends on the internuclear distance and on one ellipsoidal coordinate. The arbitrary functions are varied to optimize ψ. Numerical examples include several S and P states of muonic molecules. (auth)

Collision Phenomena

Refer also to abstracts 51625, 51641, 51901, and 52105.

51387 (BNWL-1051(Pt.2), pp 200-3) ELECTRON EJECTION FROM GASEOUS TARGETS BY HIGH-ENERGY PROTON IMPACT. Toburen, L. H.; Glass, W. A.; Braby, L. A. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Apparatus to be used for measurements of the energy and angular distribution of electrons ejected from gaseous targets by 500-keV to 2-MeV protons is described. The system employs an electrostatic energy analyzer instead of the previously used time-of-flight system. Preliminary data for the energy spectra of electrons ejected from N_2 and He by 1.7-MeV protons are included. (A.G.W.)

51388 (NP-18037) INELASTIC AND ELASTIC SCATTERING OF ELECTRONS BY ATOMS (EXPERIMENTS AND THEORIES). Vriens, Leendert (Utrecht Rijksuniversiteit (Netherlands)). 1968. 87p. Dep. CFSTI (U. S. Sales Only).

Thesis.

The three chapters of this thesis chiefly deal with inelastic and elastic scattering of electrons by atoms, in particular by helium. In the first chapter a crossed-beam experiment initiated by the author in Utrecht is described, and electron-impact cross sections for excitation to the metastable states of helium and for ionization from these states and from the ground state are reported. The second chapter deals with (1) experimental work performed while the author, was a guest worker at the National Bureau of Standards in Washington, D. C., and with (2) theoretical work done in Utrecht and Washington. In Washington, an electron spectrometer was used to measure differential cross sections for elastic scattering and for 2^3S, 2^1S and 2^1P excitation of helium by 100- to 400-eV electrons. Analytical (theoretical) extrapolation techniques and integrating also yielded total cross sections. The results for exchange scattering (experiment for 2^3S excitation and theory for elastic scattering) cast serious doubt upon the validity of all exchange approximations used up to now in cross-section calculations. The third chapter deals with the so called binary-encounter and classical collision theories. In this class of approximate treatments of atomic collisions, one starts with calculating the probability of an encounter in which a definite amount of momentum is transferred from an incident particle to one of the electrons in a target system, and then makes realistic assumptions about the initial conditions of the target electrons to obtain a cross section for an inelastic process of interest. Contributions are made in three ways to this field: first, in deriving a rather complete set of exact cross-section formulas for a pair of free colliding charged particles in an arbitrary frame in nonrelativistic quantum mechanics; second, in the application and choice of approximate models to calculate atomic cross sections; third, in testing the range of validity of this approximate theory. (auth)

51389 LOW-ENERGY ELECTRON-IMPACT STUDY OF THE 12- TO 14-eV TRANSITIONS IN NITROGEN. Williams III, Albert J.; Doering, John P. (Johns Hopkins Univ., Baltimore). J. Chem. Phys., 51: 2859-65(Oct. 1, 1969).

A high-resolution low-energy electron spectrometer was constructed and used to study the nitrogen energy-loss spectrum in the 12- to 14-eV region. The relative intensities of the v' = 2, 3, and 4 bands of the $b^1\Pi_u \leftarrow X^1\Sigma_g^+$ transition between 12.65 and 12.84 eV and the intense 12.92-eV composite transition were studied in detail at primary energies from 15 to 50 eV and scattering angles of 1 to 40°. The relative intensities of the bands of $b^1\Pi_u \leftarrow X^1\Sigma_g^+$ up to v' = 4 were found to remain invariant with respect to changes in primary energy and scattering angle. However, the ratio of the 12.93-eV peak to the 12.84-eV $b^1\Pi_u \leftarrow X^1\Sigma_g^+$ (4-0) transition decreased by a factor of 3, with increasing scattering angle from 1 to 40°, independent of primary energy. The strong angular dependence of the relative intensities for these transitions suggests that the differential scattering cross section for the $p^1\Sigma_u^+$ Rydberg state at 12.93 eV is much more strongly peaked in the forward direction than that for the $b^1\Pi_u$ state. The effect of multiple scattering on these transitions was investigated. At low energies, the intensity of a peak at 13.2 eV increased relative to the $b^1\Pi_u$ bands with increasing scattering angle. There may be a singlet–triplet transition at this energy. (auth)

51390 ENERGY DEPENDENCE OF THE SINGLET EXCITATION CROSS SECTIONS OF HELIUM EXCITED BY FAST PROTONS. Scharmann, A.; Schartner, K.-H. (Univ., Giessen, Ger.). Z. Phys., 228: 254-63(1969). (In German).

The energy dependence of the n^1S(n = 3, 4, 5), n^1D(n = 3, 4, 5), and n^1P(n = 3, 4) levels of helium excited by protons was determined in the energy range from 100 keV to 1 MeV. The measurements are compared with other experiments in the same energy range and with the results of calculations using the first Born approximation. This comparison shows that the first Born approximation is not valid below 1 MeV proton energy, except perhaps below 500 keV for the n^1P levels. It demonstrates the necessity for more accurate measurements in the 100-keV region and above 1 MeV proton energy. (auth)

51391 INVESTIGATION OF THE LINE WIDTHS OF DISCRETE ENERGY LOSSES IN Ar^+–Ar COLLISIONS. Afrosimov, V. V.; Gordeev, Yu. S.; Polyanskii, A. M.; Shergin, A. P. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksp. Teor. Fiz., 57: 806-18(July 1969). (In Russian).

A method for investigation of inelastic energy loss spectra in atomic collisions is developed, based on measurement of the kinetic energies of the two atomic particles after the collision. The method can be employed for determining the natural widths and to make more refined determinations of the discrete loss of line energies for Ar^+–Ar previously studied by a different method. The line widths and energies were measured at an initial kinetic energy of 25 keV and initial scattering angle of 16°; various elementary processes of changing the charge state of the two particles could occur in these cases. Under the collision conditions studied, three loss lines R_I, R_{II} and R_{III} are excited; the line energies are of the order of hundreds of eV and line widths of several tens eV. It is shown that the R_{II} and R_{III} lines can be regarded as being the result of simultaneous excitation of line R_I with least energy and respectively of one ($R_{I\text{-}II} \approx 258$ eV) or two ($R_{I\text{-}II}$ and $R_{II\text{-}III} \approx 272$ eV) levels with a natural width ~65 eV. Excitation of each of the levels ($R_{I\text{-}II}$, $R_{II\text{-}III}$) is accompanied by additional removal on the average of 1.5 electrons from the colliding particles. Estimates show that at small internuclear distances the system consisting of two atomic particles produced in the collision, the Ar_2^+ quasi molecule, should be in a highly excited state. The discrete inelastic losses can be explained by excitation and decay of auto-ionization states produced in the collisions. The R_I line is ascribed to autoionization transitions in the outer (M) shells of the particles accompanied by excitation of a large number of M electrons. The $R_{I\text{-}II}$ and $R_{II\text{-}III}$ levels are ascribed to auto-ionization arising on removal of electrons from the inner (L) shells. For explanation of the level widths and energies it is suggested that the model of L vacancy formation for Ar^+–Ar proposed by Fano (Phys. Rev. Lett., 14: 627(1965)) and Lichten (Phys. Rev., 164: 131(1967)) be extended by taking into account auto-ionization transitions in the quasi molecule, i.e., before separation of the particles. (auth)

51392 CHEMICAL REACTION KINETICS. XII. COLLISION MECHANISM OF D TRANSFER REACTIONS BETWEEN D_2 AND CO_2^+, D_2O^+, AND H_2S^+. Ding, A. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Z. Naturforsch., 24a: 856-7(May 1969). (In German).

The energy distributions of the product ions were measured in the forward direction as a function of the energy of primary ions of CO_2^+, D_2O^+, and H_2S^+ with D_2 as the target gas. The energy at which the reaction mechanism changes from a stripping mechanism to a mechanism involving formation of an isotropically decaying intermediate complex was calculated for all three reactions. In the case of D_2O^+ and CO_2^+, the E_3/E_1 ratio (E_3 = energy of product ions and E_1 = energy of incident ions) is considerably larger than would be expected from the stripping model. The reaction with H_2S^+ has an activation energy of about 0.15 eV, which can be traced back to a small endothermicity of the reaction. (J.S.R.)

51393 EXAMINATION OF SPECTRUM OF ^{32}P BETA PARTICLE BREMSSTRAHLUNG RADIATION. Jagielak, Jan (Centralne Laboratorium Ochrony Radiologicznej, Warsaw). Nukleonika, 13: 1047-59(1968). (In Polish).

Bremsstrahlung from ^{32}P beta particles stopped in beryllium, carbon, aluminum, iron, silver, lead, and water were measured and examined. Measurements of the bremsstrahlung spectra and beta-particle spectra of the source were examined by scintillation spectrophotometers. The experimental results are compared with the theoretical spectra. The theoretical spectra were calculated by application of cross section differential equations of Bethe–Heitler, Bethe–Heitler–Elvert, and Wyard. General recommendations concerning the application of the theoretical equations of this work to study the relation of beta-particle energy and the atomic number Z of the target material are given. (auth)

51394 ENERGY DEPENDENCE OF THE CHEMICAL IONIZATION REACTION $H(2S) + H_2 \rightarrow H_3^+ + e^-$. Comes, F. J.; Wenning, U. (Univ., Bonn). Z. Naturforsch., 24a: 1227-34 (Aug. 1969). (In German).

The chemiionization in hydrogen is measured with the aid of the photodissociation of the H_2 molecules. Only the reaction of hydrogen atoms is discussed in this paper. The atoms are produced by the photoabsorption of special wavelengths in the region between the dissociation and ionization limit thereby forming metastable 2S atoms with a well defined kinetic energy. The energy dependence of the reaction cross section is determined; it follows a v^{-n} law, where n is found to be between 2 and 3 and v is the velocity of the atoms. (auth)

51395 STATES $2p^6$, $2p^53s$, $2p^53p$, AND $2p^54s$ OF ATOMIC Ne. II. OSCILLATOR STRENGTHS AND CROSS SECTIONS FOR EXCITATION BY ELECTRON IMPACT. Vainshtein, L. A.; Minaeva, L. A. Zh. Prikl. Spektrosk., 9: 60-70(July 1968). (In Russian).

Effective cross sections for excitation of atomic Ne by electrons were calculated and averaged according to the Maxwellian distribution of rates for the different transitions between the levels of the configurations $2p^6$, $2p^53s$, $2p^53p$, and $2p^54s$. Calculations were carried out by the Born approximation and the exchange interaction was accounted for by the method proposed V. I. Ochkur. The improved wave functions utilized the intermediate-coupling approximation. Oscillator strengths were calculated for optically excited transitions and formulas for the effective cross section of excitation are given in LS and jl approximations; also, a case is shown in which the initial state is described by LS, and the final state by jl approximations. (tr-auth)

51396 LOW-ENERGY ELECTRON-IMPACT STUDY OF THE FIRST, SECOND, AND THIRD TRIPLET STATES OF BENZENE. Doering, John P. (Johns Hopkins Univ., Baltimore). J. Chem. Phys., 51: 2866-70(Oct. 1, 1969).

The six lowest excited states of benzene were investigated in the gas-phase free molecule at low pressure by electron-impact spectroscopy. Incident electron energies of 13.6 and 20.0 eV and scattering angles from 9° to 80° were used. Three singlet–singlet transitions at 5.0, 6.2, and 6.9 eV were identified. These transitions agree with the results of optical absorption and higher-energy electron-impact experiments. In addition, three triplet states were observed at 3.9, 4.7, and 5.6 eV. The positions of the first two triplet states agreed with optical data on solid benzene and threshold electron-impact experiments. The third triplet state at 5.6 eV was assigned on the basis of the relative intensity of the transition at various scattering angles. The ratio of the intensity of this transition to the allowed singlet–singlet transition at 6.9 eV was in a constant proportion to the corresponding ratio for the first triplet (3.9 eV) at all scattering angles. The spacings of the first and second and second and third triplet states in benzene were determined to be 0.80 and 0.85 eV. The difference in the spacing is not significant with respect to experimental error. (auth)

Atomic Theory

Refer also to abstracts 51823, 51825, and 51868.

51397 GENERAL APPROACH TO FRACTIONAL PARENTAGE COEFFICIENTS. Moshinsky, M. (Univ. de Mexico, Mexico City); Devi, V. Syamala. J. Math. Phys. (N. Y.), 10: 455-66(Mar. 1969).

The problems involved in the determination of a closed formula for fractional parentage coefficients (fpc) are discussed. The connection between the fpc and one-block Wigner coefficients of a unitary group of dimension equal to that of the number of states is explicitly derived. Furthermore, these Wigner coefficients are decomposed into ones characterized by a canonical chain of subgroups (for which an explicit formula is given) and transformation brackets from the canonical to the physical chain. It is in the explicit and systematic determination of the states in the latter chain that the main difficulty appears. The case of the p shell is analyzed fully to show that a complete nonorthonormal set of states in the physical chain $U(3) \supset R(3)$ can be derived easily using Littlewood's procedure for the reduction of irreducible representations (IR) of SU(3) with respect to the subgroup R(3). This procedure gives a deeper understanding of the free exponent appearing in the polynomials in the creation operators defining the states in the $U(3) \supset R(3)$ chain. As Littlewood's procedure applies to the $U(n) \supset R(n)$ chain and probably can be generalized to other noncanonical chains of groups, it opens the possibility of obtaining general closed formulas for the fpc in a nonorthonormal basis. (auth)

Cosmic Radiation

Refer also to abstracts 50129, 51264–51266, 51329, 51343, 51346, 51355, 51833, 51835, and 51853.

51398 (AD-689283) HEAVY PARTICLES IN PRIMARY COSMIC RADIATION. Final Scientific Report, July 1, 1966–April 30, 1969. von Friesen, Sten (Lund Univ. (Sweden). Dept. of Physics). Apr. 1969. 26p. (AFOSR-69-1491-TR). CFSTI.

The research program included studies of the composition and the energy spectrum of the primary cosmic radiation and studies of nucleus–nucleus interactions at medium and high energies. The investigations were performed with nuclear emulsions exposed to primary radiation in high-altitude balloon flights or in

sounding rocket flights. The investigations of the primary radiation were mainly concentrated on studies of the composition of the flux of heavy primaries. One of the main purposes of the research was to investigate the composition of the radiation in different energy intervals. An investigation of the isotopic composition of carbon in the primary flux was also performed. The studies of the nucleus-nucleus collisions were concentrated on such interactions in which the primary particles either have had an energy larger than 2 GeV/nucleon or have had an energy in the interval 100 to 400 MeV/nucleon. Comparisons between nucleus-nucleus interactions were performed in both energy intervals. (auth) (USGRDR)

51399 (INR-1065) ESTIMATION OF THE UPPER LIMIT OF THE ANISOTROPY OF MUON-POOR SHOWERS. Jatczak, Jerzy (Institute of Nuclear Research, Warsaw (Poland)). 1969. 21p. Dep. CFSTI (U. S. Sales Only).

The distribution of the intensity of muon-poor showers is calculated as a function of sidereal time. Direct Fourier analysis does not make it possible to establish whether or not the intensity of such showers depends on the value of the right ascension. On the basis of statistical analysis and Monte Carlo calculations it is estimated that the upper limit of the anisotropy does not exceed 5%. (auth)

51400 MEASUREMENT OF THE INTENSITY OF GAMMA RAYS WITH AN ENERGY FROM 0.3 TO 3 MeV AT VARIOUS ATMOSPHERIC DEPTHS. Lenin, A. S.; Romanov, A. M.; Chukin, E. I. (Ioffe Inst. of Physics and Tech., Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 9: 117-19(1969).

Translated from Geomagn. Aeron., 9: 148-9(1969).

The height dependence of the global intensity of secondary γ quanta with E = 0.3 to 3 MeV was measured in May 1966 and June 1967 by means of high-altitude balloons at a point at geomagnetic latitude ϕ = 47°N. The γ rays were recorded by means of a CsI(Tl) crystal 4 mm in diameter and 40 mm high. The data are described. (M.O.W.)

51401 DETERMINATION OF COUPLING COEFFICIENTS FROM THE AZIMUTHAL EFFECT OF COSMIC RAYS. Bel'skii, S. A.; Dmitriev, B. A.; Romanov, A. M. (Ioffe Inst. of Physics and Tech., Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 9: 119-20(1969).

Translated from Geomagn. Aeron., 9: 150-3(1969).

Cosmic-ray measurements were made at various Zenith angles at geomagnetic latitude 57°N at sea level in December 1963. The data obtained from a double-coincidence telescope measuring the directional intensity of the total charged-particle component of cosmic rays were analyzed. The records were made simultaneously at Zenith angles of 0, 12, 24, 36, 48, 60, 72, and 84° at opposite azimuths with an absorber thickness of 16 g · cm^{-2}. (M.O.W.)

51402 INFLUENCE OF THE SECTOR STRUCTURE OF THE INTERPLANETARY MAGNETIC FIELD ON COSMIC-RAY INTENSITY AND ON THE GEOMAGNETIC FIELD. Dusmanovich, A. G.; Kolomeyets, E. V.; Sergeyeva, G. A. (Kazak State Univ., Alma-Ata, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.), 9: 37-40 (1969).

Translated from Geomagn. Aeron., 9: 47-52(1969).

The relation of the intensity and anisotropy of cosmic rays and of the characteristics of the geomagnetic field to the sector structure of the interplanetary field is investigated. It is found that cosmic-ray intensity is lower in sectors where the field is directed toward the sun. The rotation of the anisotropy vector as the earth crosses the boundaries of the sectors is examined. The velocity of the solar wind and the intensity of the coronal 5303 Å line are higher in sectors where the field is directed away from the sun. (auth)

51403 BEHAVIOR OF THE DIURNAL COSMIC-RAY VARIATION PRIOR TO A FORBUSH EFFECT. Zwanzig, W.; Garzke, K.; Ruppe, F. (Univ. Halle, Ger.). Geomagn. Aeron. (USSR) (Engl. Transl.), 9: 32-6(1969).

Translated from Geomagn. Aeron., 9: 41-6(1969).

In half of all Forbush effects for which an increase in the amplitude of diurnal variation and a simultaneous time shift of the maximum toward the beginning of the day were established, the diurnal variation behaved similarly over a period of from 1 to 4 days prior to the Forbush effect. The behavior of the diurnal variation prior to the Forbush effect was determined by statistical analysis. The results obtained attest to the fact that the magnetic field frozen into a corpuscular stream of the second type is oriented perpendicularly to the plane of the ecliptic. Orientations of the magnetic field parallel or perpendicular to the plane of the ecliptic in a corpuscular stream of the second type are apparently equally probable. (auth)

51404 INVESTIGATION OF EXCESS RADIATION IN EQUATORIAL REGIONS BY COSMOS 137. Savun, O. I. (Moscow State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.), 9: 114-15(1969).

Translated from Geomagn. Aeron., 9: 145-6(1969).

The gas-discharge counters on the Cosmos 137 satellite are described. Count rates of radiation are given as a function of time. (M.O.W.)

51405 DYNAMICAL PROPERTIES AND EFFECTS OF COSMIC RAYS IN THE GALAXY. Parker, E. N. (Univ. of Chicago). pp 237-52 of Plasma Instabilities in Astrophysics. Wentzel, Donat G.; Tidman, Derek A. (eds.). New York, Gordon and Breach, Science Publishers, Inc., 1969.

From International Conference on Plasma Instabilities in Astrophysics, Pacific Grove, Calif. See CONF-681042.

The nature and properties of cosmic rays and their dynamical effects in the disk of the Galaxy are briefly reviewed. The various major problems presently subject to active research are mentioned. The paper should be considered more as a guide to the theoretical literature, than an exposition of the problems themselves. (W.D.M.)

51406 FRAGMENTATION OF COSMIC-RAY NUCLEI IN INTERSTELLAR HYDROGEN. Waddington, C. J. (Univ. of Minnesota, Minneapolis). Astrophys. Space Sci., 5: 3-17(Sept. 1969).

In order to calculate the effects of traversal of interstellar matter on the charge spectrum of cosmic radiation it is necessary to have values for the fragmentation parameters of nuclei of each element into all lighter elements. Most of these values have not been experimentally determined. As a consequence, they were calculated from a semi-empirical mass spallation relation designed to fit the available partial cross sections obtained from radiochemical determinations. This calculation attempted to take into account the conditions that are peculiar to the cosmic-ray problem. Values of the parameters are given for three characteristic energies and a comparison is made with the scarce experimental data. The effects of using these parameters in a calculation of the extrapolation of the charge spectrum through interstellar space are shown for some representative cases. (auth)

51407 OBSERVATIONS ON THE ABUNDANCE OF NITROGEN IN THE PRIMARY COSMIC RADIATION. Lezniak, J. A.; Ormes, J. F.; Von Rosenvinge, T. T.; Webber, W. R. (Univ. of Minnesota, Minneapolis). Astrophys. Space Sci., 5: 103-12(Sept. 1969).

New measurements of the intensity and spectrum of cosmic nitrogen nuclei made by instruments flown on balloons and on the Pioneer-8 space probe are reported. The nitrogen spectrum is found to be identical with that of the other medium nuclei, carbon and oxygen, over the range of measurement from 100 MeV/nuc to >22 GeV/nuc. The ratio of N to all M nuclei is found to be =0.125, constant to within 10% over this energy range. This ratio is extrapolated to the cosmic-ray source using the most recently obtained abundances of oxygen and heavier nuclei and fragmentation parameters for the production of nitrogen from these nuclei. Taking an average material path length of 4 g/cm^2 of hydrogen constant with energy, as required to make the abundance of L nuclei → 0 at the cosmic-ray source, the resulting N/M source ratio is ≤0.03. In other words, to the same degree that the so-called L nuclei are absent in the cosmic-ray sources, N nuclei are also absent. This nitrogen abundance is therefore different from the estimated solar atmospheric abundance of ~0.10 for the N/M ratio which is believed to represent the integrated effects of nucleosynthesis in the Galaxy at the time of the formation of the Sun. Nevertheless, under certain conditions in the CNO bi-cycle that operates for the production of nitrogen in stellar objects a negligible production of nitrogen might be expected. It is suggested that these conditions exist in the cosmic-ray sources. The C/O ratio of 0.9 deduced for cosmic-ray sources is compatible with the observed low nitrogen abundance arising in this CNO bi-cycle. (auth)

51408 ON THE ENERGY DEPENDENCE OF THE RATIO OF Li, Be, AND B TO C, N, O, AND F NUCLEI IN THE PRIMARY COSMIC RAYS. Biswas, S. (Tata Inst. of Fundamental Research, Bombay). Astrophys. Space Sci., 5: 59-67(Sept, 1969).

A critical study of all available data on the energy dependence of the ratio of the intensities of Li, Be, and B to C, N, O, and F nuclei (L/M ratio) in cosmic rays is made. It seems that in a recent experiment by Von Rosenvinge et al. (1969), the flux of M nuclei came out higher in the energy interval of 200 to 400 MeV/nucleon and that of L nuclei lower in the energy interval 400 to 600 MeV/nucleon; as a result they obtained a value of the ratio of L/M which is about 50% lower than all other investigators. The results of all other studies yield the best estimate of the ratio

of L/M as 0.26 ± 0.03, 0.41 ± 0.03, and 0.26 ± 0.02 in the energy interval 50 to 150, 200 to 600, and >1500 MeV/nucleon respectively. (auth)

51409 THE ISOTOPIC ABUNDANCES AND ENERGY SPECTRA OF ^{2}H, ^{3}He, AND ^{4}He OF COSMIC-RAY ORIGIN IN THE ENERGY REGION ~10 TO 100 MeV NUCLEON^{-1}. Hsieh, K. C.; Simpson, J. A. (Univ. of Chicago). Astrophys. J., 158: L37-41 (Oct. 1969).

The IMP-4 satellite carried an instrument capable of resolving the H and He isotopes. The differential energy spectrum of ^{2}H from 6 to 60 MeV nucleon^{-1}, along with simultaneous measurements of ^{3}He and ^{4}He, was obtained during the 1967 solar quiet times in interplanetary space. These measurements show that (1) an ^{2}H flux exists whose magnitude is not accounted for by current ideas for cosmic-ray transport in the Galaxy; (2) by using the ^{2}H as a tracer for a component of galactic origin in interplanetary space it is found that the solar-proton component (1967) must be less than 15% of the interplanetary proton flux at 20 MeV; and (3) present forms of solar-modulation theory must be modified at low energies to account for the observations. (auth)

51410 PRIMARY COSMIC-RAY ELECTRON ENERGY SPECTRUM FROM 10 TO 200 MeV OBSERVED IN INTERPLANETARY SPACE. Fan, C. Y.; L'Heureux, J.; Meyer, Peter (Univ. of Chicago). Phys. Rev. Lett., 23: 877-80(Oct. 13, 1969).

The quiet-time flux and energy spectrum of primary cosmic-ray electrons in the energy range from 10 to 200 MeV in interplanetary space was measured. This investigation was carried out with an instrument on board the satellite OGO-5 and covers the period from 25 March to 25 April 1968. (auth)

Direct Energy Conversion

Refer also to abstracts 51424 and 51432.

51411 (AD-674882) RESEARCH AND DEVELOPMENT PROGRAM OF THERMIONIC CONVERSION OF HEAT TO ELECTRICITY. VOLUME I. Final Technical Summary Report. (General Electric Co., Pleasanton, Calif. Nuclear Thermionic Power Operation). July 1968. Contract NObs-90496. 105p. (GEST-2062(Vol.1)). CFSTI.

The diffusion rates of uranium through tungsten when the tungsten is used to encapsulate urania were determined in the temperature range between 1800 and 2000C. Similarly the diffusion rates of uranium through molybdenum when the molybdenum is used to encapsulate urania were determined in the temperature range between 1600 and 1750C. It was generally concluded that the steady-state diffusion rates are of such magnitude that uranium diffusion through both tungsten and molybdenum is not likely to affect their performance as thermionic emitters. The activation energy and diffusivities for the diffusion of oxygen through polycrystalline molybdenum were determined in the temperature range 1500 to 1800C. A mass spectrometric and thermogravimetric study of the equilibrium interaction between alumina and niobium between 1500 and 1900C was also conducted. (USGRDR)

51412 (CEA-CONF-1034) USE OF TITANIUM ALLOYS IN THERMIONIC CONVERSION. Clemot, M.; Durand, J. P.; Segurens, L.; Josso, E. R. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). [nd]. 10p. (In French). (CONF-680542-1). Dep.

From International Conference on Titanium, London, England.

Sixty Ti alloys (binary alloys with Zr, Si, Sn, Gd, Ce, and Al and ternary alloys of Ti-Al with V, Zr, Mo, Nb, Y, C, Sn, Ge, and Si) were studied with respect to their use in thermionic converters. The Ti-Al alloys showed an upper limit of 200 $\mu\Omega$cm for the electric resistivity. This value can not easily be exceeded if the possibilities of metallurgical transformations are to be preserved. Some thermionic converters were realized with tubes obtained by hot drawing followed by an internal-external rectification pass. (tr-auth)

51413 (CEA-R-3867) IN-PILE EXPERIMENTAL DEVICE FOR SIRENE THERMIONIC CONVERTERS. Bliaux, Jean; Durand, Jean-Paul; Lazare-Chopard, Gilbert (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Aug. 1969. 19p. (In French). Dep. CFSTI (U. S. Sales Only).

The irradiation device described was built for in-pile life tests of 100-W(e) SIRENE converters. The nuclear converter is located in a sealed vacuum chamber, which is plugged at the lower end of a coaxial tubing acting as electrical leads. The output power is available on a variable resistive load on the bank of the reactor pool. Thermal, electrical, and neutronic parameters of the converter are recorded. Since 1967, two permanent devices allowed five experiments in the swimming pool TRITON (CEN-FAR) and results, up to the present, are presented. (auth)

51414 OUTPUT CHARACTERISTICS OF CESIUM DIODES WITH ZIRCONIUM DIBORIDE CATHODES. Semenchenkov, A. T.; Kobylkin, A. N.; Osipov, E. K.; Ivanov, O. S. (Inst. of Metallurgy, Moscow). Teplofiz. Vys. Temp., 6: 826-9(Sept.-Oct. 1968). (In Russian).

The volt-ampere characteristics of cathodes of ZrB_2 coated on tantalum in cesium diodes with cathode temperatures of 1500, 1600, and 1700°C and interelectrode clearances of 0.5 mm were studied. It was established that ZrB_2-coated cathodes possess low output characteristics at 1500 to 1700°C. Maximum output power at the optimum cesium vapor pressure of 6.6 and 8.7 mm Hg was 0.4 to 1.7 W/cm^2 with current density 1 to 3.5 A/cm^2 and output voltage 0.3 to 0.5 V. (tr-auth)

51415 THE ELECTRIC FIELD DISTRIBUTION AND ENERGY CONVERSION IN AN OPEN-CHANNEL MHD FLOW. Amitin, M. B.; Vulis, L. A.; Genkin, A. L.; Dzhaugashtin, K. E. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 2, 116-26(Apr.-June 1969). (In Russian).

Experimental results are presented on effects of two-dimensional electric field in the channel of an MHD trough, characterizing the end effects, and the influence of hydraulic jumps. Data obtained are compared with approximate calculations of flow in the trough, considering hydraulic discontinuities and end effects. (tr-auth)

51416 TRANSVERSE MAGNETIC FIELD INFLUENCE ON THE THERMOEMISSION CONVERTOR OPERATING IN KNUDSEN REGIME. Ender, A. Ya. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekh. Fiz., 38: 1925-33(Nov. 1968). (In Russian).

A method was suggested for calculating the current at arbitrary distribution of the potential along the gap. Variations of the potential in narrow near-electrode regions were studied in detail. It was found that the sign and the magnitude of the near-anode barrier exerted a significant influence on the current traversing a converter (which operates in a transverse magnetic field). With the accelerating (for electrons) near-anode jump the current flowing through the converter is determined by the potential of plasma near the anode. The experimental volt-ampere characteristics are used for studying the near-electrode shocks. (R.V.J.)

51417 CIRCULATING CURRENTS IN THE MHD GENERATOR CHANNEL. Celinski, Z. (Inst. of Nuclear Research, Warsaw). Arch. Elektrotech. (Warsaw), 18: 339-46(1969).

The electrical parameters of the MHD generator are usually calculated with the simplifying assumption that all gasdynamic parameters in a generator channel are constant. Actually, the gasdynamic parameters are not constant, but are functions of the spatial coordinates x, y, z, and time. The spatial nonuniformity of the gasdynamic parameters leads to the formation of the circulating currents in the plasma flow. They affect the electrical parameters of the generator. In the analysis presented, steady plasma flow is assumed, i.e., all time derivatives are zero. Conditions for the formation of circulating currents in the MHD generator channel are described. The circulating currents arise due to nonuniformity of the gas parameters and magnetic induction vector. They provide a physical mechanism for the averaging of the nonuniform electric fields induced in plasma. The fundamental mathematical expressions are derived and physically explained. (BBB)

51418 PROGRESS IN MHD POWER GENERATION. PART 2. George, D. W. (Univ. of Sydney). Elec. Eng. (Melbourne), 46: 32-4(May 1969).

A steady-state MHD generator experiment at Sydney University's School of Electrical Engineering is described. The facility is powered by a 40-kW arc torch and operates with argon seeded with K_2SO_4. Excellent control of all variables is obtained and close study of electrode and other boundary problems are possible. The important role of the positive ions crossing the electrode/plasma boundary layer from the plasma side was demonstrated when the electrode temperatures fall below a certain critical value and the breakdown of these layers at high current densities was studied. Properties of the plasma medium itself were studied both in the facility and in two-temperature static furnaces. "Enhanced" conductivities of argon and helium by elevation of the electron temperature without raising the gas temperature have been observed. An experiment to investigate some aspects of liquid-metal MHD generation is described. Outstanding research problems relating to the development of MHD power generation are described and its economic prospects are assessed. (Australia)

51419 SPACE CHARGE IN THE MHD GENERATOR CHANNEL. Celinski, Z. (Inst. of Nuclear Research, Swierk, Poland). Arch. Elektrotech. (Warsaw), 18: 103-16(1969).

The conditions for the space charge formation in the MHD

generator channel are described. These are shown to be spatial nonuniformity of the gas parameters and the magnetic induction vector in the MHD generator channel. Demonstrations of the relation are both mathematical and experimental. The possible physical mechanisms of space charge formation are indicated and qualitatively discussed. The fundamental mathematical expressions are derived as well. In the considerations the steady plasma flow is assumed. Quantitative analysis of the problem is required to separate from the great number of possible mechanisms those of greatest influence on generator operation. The space charge in the generator channel leads to nonuniform distribution of electrical values; each nonuniformity results in deterioration of the electrical efficiency of the generator. (BBB)

51420 ELECTROGASDYNAMICS. Sciences (N.Y.), 8: 11-13 (May 1968).

Electrogasdynamics (EGD) offers the possibility of a revolutionary change of the power industry. Difficulties imposed by the extreme operating temperatures of the MHD converter are eliminated by converters based on the EGD principle. Working in a manner similar to a Van de Graaf generator, an EGD converter can use a moving gas to transport charge carriers from one point to another. Within an inlet corona discharge, as molecular gas ions are formed, they collide with microscopic combustion particles. The gas then carries these charged particles to the other end of the channel. The flow of gas and particles forces the ions down the tube, resulting in a current of extremely high voltage. The device can be converted to a compressor by applying an external high voltage to the electrodes, thereby pulling charged particles through the gas, resulting in compression. In another application, the particles in automobile exhaust can be precipitated onto an exhaust pipe attachment. EGD may find eventual use in central station power plants, high-energy particle accelerators, electron beam welding, x-ray machines for process irradiation of foods, metals, and plastics, air pollution control, water desalination, gas compression, and other applications. (BBB)

51421 THE EFFICIENCY OF EHD ENERGY CONVERTERS. Bortnikov, Yu. S.; Rubashov, I. B. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 2, 102-6(Apr.-June 1969). (In Russian).

Theoretical and experimental data were obtained on the efficiency of EHD generator and ion-convection pump. A system of equations describing interactions of a unipolar charged fluid with an electric field was used for obtaining expressions determining the internal emf of convertors. Moreover, it was shown that the efficiency of EHD convertors in optimum cases depend only on the working area complex of physical forces and the mobility the charge carrier in it. Experimental data obtained on the performance of the EHD generator and ion-convection pump operations with dielectric fluids showed a good agreement with the efficiency of convertors and theoretical data. (tr-auth)

Fluid Physics

Refer also to abstracts 51415, 51417, and 51421.

51422 ON THE UNSTEADY FLOW OF CONDUCTING LIQUID BETWEEN TWO PARALLEL PLATES. Baral, M. C. (Tripura Engineering Coll., India). Proc. Natl. Inst. Sci. India, Part A, 35: 422-7(May 1969).

The unsteady flow of viscous conducting liquid between two parallel plates, when one of them is set in motion parallel to the other by a periodic force, has been discussed by using the methods of Laplace transforms. (auth)

51423 PHASE VELOCITY AND ENERGY LOSS IN MAGNETO-THERMO-ELASTIC PLANE WAVES. Chander, Subash (Univ. of Delhi). Int. J. Eng. Sci., 6: 409-24(Aug. 1968).

Phase velocities and energy losses for the magneto-thermo-elastic dilational plane waves propagating through an electrically conducting infinite medium are investigated. The properties of the elastic, thermal, and magnetic modes are studied and relations are given expressing the variation in each of the phase velocity, amplitude attenuation, and the specific loss with the impressed frequency. Amplitude ratios of the thermo-elastic and magneto-elastic waves are computed for each of the three modes. Their limiting values at high and low frequencies are also discussed. Numerical details are given for metals at room temperature, to show the order of the coupling between elastic, thermal, and magnetic interactions. In the discussion on phase velocities and specific losses for magneto-thermo-elastic plane waves for weak coupling of the magnetic and thermal fields, it is shown that at very high frequencies the elastic wave disturbance propagates with the dimensionless phase velocity "1," of the pure dilational wave. The phase velocity, however, increases from unity to $(1 + \epsilon + \epsilon_1)^{1/2}$ at vanishingly small frequencies. The specific loss, being zero at zero frequency, reaches a maximum value and then decreases to zero at very large frequencies. In the general case when the magneto-thermo-elastic coupling is not very weak, the specific loss decreases by a factor $(1 + \epsilon + \epsilon_1)^{-1}$ at vanishingly small frequencies. For a weak coupling, the phase velocity of the magnetic mode shoots tangentially from its zero value to a large number with its rate of increase tending to zero at infinitely large frequencies. The specific loss, however, decreases from its value 4π, reaches a minimum value and then again approaches 4π as the frequency increases from zero to infinity. The thermal mode also behaves in a similar way. Numerical observations indicated that magnetic coupling is very weak as compared with thermal coupling. Maximum value of the specific loss occurs at $\omega = 3.60 \times 10^{10}$ cps. (BBB)

51424 APPLICATION OF INJECTION OF NEUTRAL GASES FOR PROTECTION OF ELECTRODES OF MHD APPARATUSES. German, V. O.; Kukoma, Yu. P.; Lyubimov, G. A.; Shchegolev, G. M. Teplofiz. Vys. Temp., 7: 133-9(Jan.-Feb. 1969). (In Russian).

Studies were made of the thermochemical protection of porous metalloceramic electrodes by the injection of neutral gases in the near-electrode boundary layers. Data are presented on the influence of injected argon, nitrogen, and argon enriched with potassium vapor on the parameters that determine the form of the volt–ampere characteristics of the electrodes. (tr-auth)

51425 VELOCITY ADJUSTMENT IN AN ANNULAR TUBE OF AN ELECTRIC-CONDUCTING LIQUID SUBJECT TO A RADIAL MAGNETIC FIELD. Vives, Charles; Daoud, Mohamed Ben (Laboratoire de Physique Industrielle, Alger, Algeria). Compt. Rend., Ser. A, 268: 1431-3(June 9, 1969). (In French).

A theoretical study is given for the velocity adjustment in an annular tube of a viscous and electric-conducting liquid subject to a radial magnetic field. The fundamental parameters and theoretical curves for several values of these parameters are given. (tr-auth)

51426 NONLINEAR DIFFERENTIAL EQUATION OF ELECTROHYDRODYNAMICS. Ackerberg, R. C. (Polytechnic Inst. of Brooklyn Graduate Center, Farmingdale, N. Y.). Proc. Roy. Soc. (London), Ser. A, 312: 129-40(Aug. 1969).

A nonlinear differential equation which governs the equilibrium of two closely spaced drops, suspended from two circular rings, and maintained at electric potentials ±V is considered. When the potential reaches a critical value V_m, experiments showed that the drops coalesce and the equation has no solutions for $V > V_m$. Two limiting cases were studied. For drops which at zero potential difference are films of zero curvature, it is shown that the equation may not have a unique solution for $V < V_m$. For drops which are nearly touching when there is no potential difference, with non-zero curvature, it is shown using the method of matched asymptotic expansions, that when the drops are about to coalesce, the original separation distance is reduced by one-half. Thus the drops are not drawn out as might have been expected from experiments on isolated drops. (auth) (UK)

51427 SOME ELECTRICALLY DRIVEN FLOWS IN MAGNETOHYDRODYNAMICS. PART 3. THE ASYMPTOTIC THEORY FOR FLOW BETWEEN CIRCULAR ELECTRODES. Hunt, J. C. R. (Central Electricity Research Labs., Surrey, Eng.); Stewartson, K. J. Fluid Mech., 38: 225-42(Sept. 3, 1969).

A complete asymptotic analysis of the distribution of velocity and electric potential in an electrically conducting liquid between two circular electrodes of finite diameter, 2b, when a current is passed between them is presented. The electrodes are set opposite to each other in insulating planes, a distance 2a apart, and a magnetic field is applied perpendicular to these planes. The asymptotic solution is obtained under the restriction that the Hartmann number M satisfies both the conditions $M \gg 1$ and $M^{1/2}l \gg 1$, where $l = b/a$. The distribution of velocity and electrical potential throughout the flow field can be calculated, and provides an expansion for the resistance R between the electrodes in descending powers of $M^{1/2}l$, which is correct provided terms of order M^{-1} and $(lM^{1/2})^{-3}$ are neglected. Comparison of the theoretical results with experiment shows good agreement in the measurements of R and in the direct probe measurements of electrical potential within the fluid. This is one of the first experiments in which direct-probe measurements of an MHD flow, as well as external measurements, have provided such a satisfactory confirmation of the theory. Direct measurements of the velocity, by means of a Pitot tube as in part 2, or by means of a hot-film anemometer undertaken by Malcolm (1968), agree less well with the theory. (auth) (UK)

51428 MAGNETOHYDRODYNAMIC FLOW BETWEEN ROTATING COAXIAL DISKS. Stephenson, C. J. (Cambridge Univ., Eng.). J. Fluid Mech., 38: 335-52(Sept. 3, 1969).

The magnetohydrodynamic flow of an incompressible viscous fluid between coaxial disks, with a uniform axial magnetic field B was studied. The fluid has density ρ, viscosity η, and electrical conductivity σ. The flow is assumed to be steady, and to be similar in the sense that the radial and tangential components of velocity increase linearly with radial distance from the axis of rotation. Most of the work is concerned with disks which are electrical insulators, one of which rotates while the other remains stationary. The imposed conditions can then be represented by the Reynolds number $R = \rho\Omega_s d^2/\eta$ and the Hartmann number $M^2 = \sigma B^2 d^2/\eta$, where Ω_s is the angular velocity of the rotating disk and d is the gap between the disks. Asymptotic solutions are given for $R \ll M^2$, and numerical solutions are obtained for values of R and M^2 up to 512. Experimental measurements are presented which are in general agreement with the theoretical flows, and the results for small values of the Hartmann number provide the first known experimental support for the purely hydrodynamic solutions in the range $100 < R < 800$. (auth) (UK)

51429 LAMINAR INCOMPRESSIBLE MHD FLOW IN A FLAT CHANNEL OF VARIABLE WIDTH. Kozyrenko, V. E.; Teplyakov, V. A. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 2, 148-51(Apr.-June 1969). (In Russian).

Conducting fluid flow in a plane channel with twisted, nonconducting walls with adjoining magnet poles, creating a field with intensity vector $\underline{H}$, was studied. A mathematical analysis is given for conductions in which the channel walls are symmetric and at the inlet were parallel to the plane, then diverging slightly in the direction of the flow. Thus, the half-width of the channel was equal to $a = a(\epsilon x)$, where ϵ = const. $\ll 1$. The axis x coincided with the axis of the channel and was directed along the current. The induced magnetic field was not considered in the analysis. (R.V.J.)

51430 MHD FLOW IN A RECTANGULAR DUCT WITH PENETRABLE WALLS AT FINITE MAGNETIC REYNOLDS NUMBER. Sych, V. M. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 2, 82-8(Apr.-June 1969). (In Russian).

Laminar conducting fluid flow in a rectangular channel in a transverse field was studied for the case in which the fluid is blown in through one electrode wall and out through the opposite while two other walls act as insulators. A direct variable Galerkin–Kantorovich method was used for the analysis of similar motions. The problem was reduced to the solution of an ordinary fourth-order differential equation. The distributions of the flow rates of induced magnetic fields and currents in the cross section of the channel are presented. (tr-auth)

51431 MAGNETOHYDRODYNAMIC BEARINGS. Bertinov, A. I.; Metlin, V. B. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 2, 3-18(Apr.-June 1969). (In Russian).

A brief review is given on the data on magnetohydrodynamic bearings published in Soviet Union and abroad. The review classified the MHD bearings according to their construction (plane, radial, thrust, and journal) and electromagnetic reaction with lubrication layer. The MHD lubricant flow and conductance of bearing surfaces and closed-circuit conditions are discussed. Geometric and electromagnetic parameters are given for some types of MHD bearings. Theoretical and experimental data indicated high efficiency of MHD bearings, as compared to ordinary, with the same lubrication. (R.V.J.)

51432 COMPRESSIBLE CONDUCTING GAS FLOW IN COAXIAL CHANNEL WITH LONGITUDINAL AND TRANSVERSE MAGNETIC FIELDS IN THE PRESENCE OF HALL EFFECT. Gorbatkov, S. A. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 2, 53-7 (Apr.-June 1969). (In Russian).

Linear axially symmetric flow of compressed anisotropic conducting gas in an external longitudinal–transverse magnetic field with segmented and solid electrodes was studied. The problem was resolved in a quasi-one-dimensional approximation by the Runge–Kutta method using an electronic computer. The basic electrodynamic and energy characteristics of the flow were found. An optimization of electrical power was calculated for the electrodes according to the Hall coefficient and the magnetic induction vector angle in relation to the channel axis. (R.V.J.)

51433 TWO-DIMENSIONAL STEADY-STATE MHD FLOW IN A CHANNEL WITH ANNULAR CROSS SECTION AND RADIAL MAGNETIC FIELD CONSIDERING HALL EFFECT. Rozenbaum, V. L.; Rotikhardt, L. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 2, 49-52(Apr.-June 1969). (In Russian).

Theoretical studies were made of the magnetohydrodynamic behavior of plasma in a coaxial channel with alternating radial magnetic field. The velocity and current density distribution were determined. An analytical solution was found for the general problem in a two-dimensional case at arbitrary Hall parameters. (tr-auth)

51434 DISTRIBUTION OF ELECTRIC POTENTIALS IN MAGNETOGASDYNAMIC CHANNELS. Apollonskii, S. M.; Kos'kin, Yu. P. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 2, 58-62(Apr.-June 1969). (In Russian).

Experimental data are given on the reduced potential in the center flow from near-electrode layers in an MGD channel at comparable small electrode current densities in the case of uniform emission from their surfaces. Results are correlated with calculations, and the importance of considering the near-electrode potential is emphasized especially for the case of small channels. (R.V.J.)

51435 MHD FLOW IN THE VICINITY OF THE CRITICAL POINT IN THE PRESENCE OF NONUNIFORM NONAZIMUTHAL MAGNETIC FIELD. Smyslov, Yu. N. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 2, 77-81(Apr.-June 1969). (In Russian).

Numerical solutions for the boundary two-parameter problem in a wide range of Alfvén numbers and diffusion numbers ($\epsilon = \nu/\nu_m$) were obtained using an electronic computer. Results are tabulated, and the effects of variable parameters $\underline{S}$ and $\underline{\epsilon}$ on distribution of velocities, friction magnitude $f''(0)$, and the ratio between viscous and current layers are analyzed. Analytical data for the cases of $\epsilon \to 0$ and $\epsilon \to \infty$ are correlated. (R.V.J.)

51436 PLANE INCOMPRESSIBLE CONDUCTING CHANNEL FLOW IN THE PRESENCE OF A TRANSVERSE PERIODIC MAGNETIC FIELD AND INJECTION. Brainin, M. I.; Churakova, S. V.; Sheinkman, A. G. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 2, 89-92(Apr.-June 1969). (In Russian).

Laminar incompressible conducting fluid flow in a rectangular channel of a finite length along two parallel nonconducting walls with injection through them and a variable pressure between the inlet and outlet was studied. The flow took place in a periodic magnetic field perpendicular to the porous walls at small magnetic Reynolds numbers. Solutions were obtained for the velocity and pressure components and for the local coefficient of friction in nonconducting walls. (tr-auth)

51437 ON THE ANALYSIS OF MHD BOUNDARY LAYERS ON DISKS. Gorbachev, L. P.; Potanin, E. P. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 2, 93-6(Apr.-June 1969). (In Russian).

The stationary MHD boundary layer on a fine dielectric disk was calculated for conducting rotating fluid flow in the presence of a homogeneous external magnetic field distributed perpendicularly to the plane of the disk. The problem was resolved by taking into account some inertia terms in the equations of motion. Numerical data were obtained for boundary layers in rotational and stationary disks and also for the case in which the fluid flows between two disks, one stationary and the other rotating at a constant angular speed. (tr-auth)

51438 MHD FLOW IN FLAT RECTANGULAR CHANNELS AT FINITE MAGNETIC REYNOLDS NUMBERS. Bertinov, A. I.; But, D. A.; Kalugin, V. N. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 2, 97-101(Apr.-June 1969). (In Russian).

Studies were made of liquid metal flow between two plane channels connected by segmented electrodes used for stabilizing the current and reducing the effects of the internal magnetic field. The magnetic Reynolds number was of significant magnitude. Both channels were placed in an external pulsating transverse magnetic field and, together with the electrodes, were encircled by a steel magnetic loop which supplied the induction coupling of channels by the external winding. The boundary conditions are assigned as constants of induction magnitudes at the inlet and outlet of the channel and linearity of induction variations on the electrodes. The magnetic current in the channel is assumed to be constant. The two-dimensional distribution of the induced current and current density in the channel was obtained by the method of separable variables. The influence of R_m on the magnitude of complex amplitude and induction and density phases of the current was estimated. It is shown that with rise of R_m, the magnetic field weakened at the inlet and increased at the outlet. (R.V.J.)

51439 CHARGED-PARTICLE DIFFUSION IN NEAR-ELECTRODE BOUNDARY LAYER. Genkin, A. L.; Lebedev, A. D. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 2, 38-48(Apr.-June 1969). (In Russian).

Electric field variations and charged particle concentration in the near-electrode boundary layer of an MHD channel were studied considering ionization diffusion processes and recombination in

gasdynamic boundary layer at various thermoemission layers. The influence of the thickness of the gasdynamic layer and density of electric current on the deviations from equilibrium distribution was observed. The influence of diffusion and the magnitude of electric current was calculated. (tr-auth)

51440 SEPARATION AND MAGNETOHYDRODYNAMICS. Buckmaster, John (University Coll., London). J. Fluid Mech., 38: 481-98(Sept. 18, 1969).

An investigation of MHD boundary layers in a transverse magnetic field when the magnetic Reynolds number (Rm) is small is described. The main purpose is to understand something about the suppression of separation by a strong magnetic field, with particular emphasis on the behavior near a rear stagnation point. Given an O(1) inviscid flow it is shown that there is a critical value of N, the interaction parameter, to completely suppress separation. This value is one half that proposed by Leibovich (1967), a discrepancy that is due to the nonregularity of the boundary-layer equations at a rear stagnation point, a possibility that Leibovich did not consider in his solution. Model linear equations suggest the true role of Leibovich's solution. The possibility of a viscous wake leaving the rear stagnation point is considered, and it is suggested that such does not arise from vorticity generated in the boundary layer. (auth) (UK)

51441 APPLICABILITY OF THE METHOD OF SUCCESSIVE APPROXIMATIONS FOR BOUNDARY LAYER CALCULATIONS IN MHD FLOW IN CHANNELS. Buznikova, L. I.; Iotkovskii, B. G.; Kirillov, V. V. Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza, No. 1, 143-8(Jan.-Feb. 1969). (In Russian).

For calculating the boundary layer at the walls in laminar flow in MHD channels, an approximation method is used as originally proposed by Shvets (Prikl. Mat. Mekh., 13: No. 3(1949)). General expressions are obtained for determination of boundary layer thickness and friction forces on the walls of MHD channels with arbitrary distribution according to the length of the channel, the velocity in the outer stream, and magnetic field induction. On the basis of this analysis it is concluded that the method of Shvets can be used in the engineering estimates of MHD problems; the error in estimates, in general, depends on the number of parameters in the magnetohydrodynamic interactions and, in most cases, does not exceed 10%. (tr-auth)

51442 EQUATIONS OF MAGNETOHYDRODYNAMICS OF PARAMAGNETIC MEDIA. Shaposhnikov, I. G.; Shliomis, M. I. Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza, No. 1, 4-7(Jan.-Feb. 1969). (In Russian).

Using conservation laws and a phenomenological method, the complete system of equations of motion for a conducting paramagnetic liquid in a magnetic field was obtained. Besides the usual equations of magnetohydrodynamics (with additional members, which consider the magnetization of the environment), this system includes the equation for the rate of change of magnetic moments. Equations of hydrodynamics of liquids with internal rotation were obtained earlier (Zh. Eksp. Teoret. Fiz., 51: No. 1 (1966)) and in a case dependent on this rotation of paramagnetic properties (Zh. Eksp. Teoret. Fiz., 53: No. 3(1967)). In the second case, a liquid with conductivity different from zero was considered; these cases of usual hydrodynamic theory are generalized here for magnetohydrodynamics. (tr-auth)

51443 ON HEAT TRANSFER IN MHD CHANNEL FLOW IN SLIP-FLOW REGIME. Soundalgekar, V. M. (Indian Inst. of Tech., Bombay). Proc. Natl. Inst. Sci. India, Part A, 35: 439-45(May 1969).

An analysis of heat transfer in a MHD channel flow of a viscous, incompressible rarefied gas is presented under slip-flow and temperature-jump boundary conditions. It is observed that an increase in K (loading parameter) leads to a decrease in Nusselt number for all λ, Γ (slip-parameter, temperature-jump coefficient). Also, with the increase in λ and Γ, there is a decrease in the Nusselt number. (auth)

Geophysics (Upper Atmosphere)

Refer also to abstracts 51288, 51402, and 51519.

51444 (AD-681438) THE MAGNETIC FIELD AND ENERGY OF AN AXISYMMETRIC VAN ALLEN BELT. Report No. Scientific-10. Chapman, S.; Kendall, P. C.; Swartztrauber, P. N.; Windle, D. W. (Sheffield Univ. (England). Dept. of Applied Mathematics and Computing Science. Alaska Univ., College. Geophysical Inst. National Center for Atmospheric Research, Boulder, Colo.). Feb. 23, 1968. 28p. (AFCRL-68-645). CFSTI.

In an earlier paper, the magnetic vector potential of an axisymmetric distribution of azimuthal electric currents was expanded in a Legendre series. It was shown that the method may be used to study the magnetic field of a geomagnetic ring current of charged particles spiraling in a dipole field. The purpose of this further work was to determine the magnetic self-energy for various model ring-current belts. (TSS) (USGRDR)

51445 (AD-687535) ANALYSIS OF IONOSPHERIC DATA. Semiannual Technical Report No. 4, October 1, 1967-March 31, 1968. Sears, Robert D. (IIT Research Inst., Chicago, Ill.). June 1968. Contract N00014-66-C-0030. 65p. (IITRI-V-6061-SA-4). CFSTI.

The average and short-term fluctuations in apparent Doppler frequency imposed upon three high-frequency short-hop propagation paths are described. The average variation in Doppler frequency during development of the reflecting region at dawn for both geomagnetically disturbed and quiet conditions can be characterized by an exponentially decaying positive Doppler signal. The small-scale Doppler-frequency fluctuations are analyzed by power spectral analysis techniques. It is shown that the power spectra usually have a constant spectral intensity at high frequencies (e.g., a white spectrum), and a slightly increasing spectral intensity at lower frequencies (e.g., a pink spectrum). The power contained in the white portion of the spectrum is shown to be correlated with the geomagnetic activity index. The average changes in Doppler frequency for quiet and disturbed daytime periods are related to the determination of the level of range and x-ray yield at which nuclear bursts in space may be detected against the natural background. Also, the natural fluctuation level of the hf Doppler signals is related to the level of x-r y yield and range at which nuclear burst effects can be distin ,uished from the natural Doppler "noise" level of an hf detection system. (auth) (USGRDR)

51446 (AD-689175) RESEARCH AND INSTRUMENTATION FOR THE STUDY OF AIRGLOW AND AURORA PHENOMENA. Final Report, March 1, 1966-December 31, 1968. Nardone, Jouis J. (Northeastern Univ., Boston, Mass.). Apr. 30, 1969. Contract AF19(628)-5731. 64p. (AFCRL-69-186). CFSTI.

Summary descriptions are presented of various studies and programs conducted on airglow and aurora phenomena, in conjunction with related events, in support of the upper-atmosphere research program. Studies involving oxygen redline emission, rocket measurements of sodium dayglow, upper atmospheric temperature measurements from the N_2^+ first negative band system, and an observed red arc are presented either in an abstracted form or in preliminary rough-draft form prior to publication. Programs in progress but not completed are briefly described. A general description of various types of instrumentation for making optical studies of the light in the atmosphere is given. The presentation offers information useful in the design of the instruments rather than detailed particulars of any one design. (auth) (USGRDR)

51447 (AD-689185) OBSERVATIONS AND STUDIES OF AURORAL IONIZATION PROCESSES. Progress Report No. 4, February 12, 1968-February 11, 1969. Skovli, Gunnar (Forsvarets Forskningsinstitutt, Kjeller (Norway)). Mar. 12, 1969. Contract F61052-68-C-0046. 10p. (AFCRL-69-206). CFSTI.

The objective of the program was to study the properties of the auroral D region in a quantitative manner. (auth) (USGRDR)

51448 (AD-689232) THE DETERMINATION OF IONOSPHERIC RECOMBINATION COEFFICIENTS, PHASE I: FEASIBILITY OF UTILIZING SOLAR FLARE-SUDDEN IONOSPHERIC DISTURBANCE RELATIONSHIPS. Final Report. Popoff, I. G.; Whitten, C.; Ludwig, F. L. (Stanford Research Inst., Menlo Park, Calif.). May 26, 1960. Contract AF29(601)-1994. 100p. (AFCRL-GRD-TR-60-289). CFSTI.

The possibility of determining recombination coefficients by utilizing solar flare-ionospheric relationships was studied. Information presently available regarding the phenomenology of solar flares was collected and is discussed, insofar as it relates to the ionizing emissions responsible for sudden ionospheric disturbances (SID). The physical principles involved in the production of ionized clouds in the atmosphere by solar x-ray, Lyman-alpha, and gamma radiation are reviewed, including consideration of the normal D layer, as well as the effect of solar flares. Previous studies of recombination coefficients are also considered. (auth) (USGRDR)

51449 (AD-689458) BREMSSTRAHLUNG IN THE LOWER IONOSPHERE. Report No. Scientific-336. Freyer III, Gustav J. (Pennsylvania State Univ., University Park. Ionosphere Research Lab.). May 15, 1969. Contract DAAD05-67-C-0642. 273p. CFSTI.

An aeronomic analysis is made of effective bremsstrahlung effects due to electrons penetrating the upper atmosphere in the auroral zone. The electron attenuation in the atmosphere is determined from a Monte Carlo model that includes electron energy loss and scattering processes. A comparison is made between experimental results and the calculated energy deposition rates. Typical electron energy and angular distributions as a function of depth of penetration are given. Bremsstrahlung production rate profiles are obtained using the Bethe–Heitler cross sections which include the angular as well as the energy dependence. Numerical calculations are made of the ion production rates for a number of electron precipitation events observed. Electron energy distributions are obtained by suitably weighting basic calculations for 5-, 10-, 15-, 25-, 35-, 50-, 70-, 100-, 150-, and 500-keV monoenergetic electrons. The bremsstrahlung ion production rates in the D region are found to be significant primarily for intense fluxes of 1 to 20-keV electrons usually associated with visible aurora. (auth) (USGRDR)

51450 (AD–689662) MODIFICATION OF THE IONOSPHERE BY RADIOWAVES. LeLevier, R. E. (RAND Corp., Santa Monica, Calif.). June 1969. 29p. (P–4125). CFSTI.

A theoretical model is presented for calculating the heating and hydrodynamic expansion of the F layer of the ionosphere due to an incident radiowave. It is found that the greatest effects occur for transmitter frequencies just above the critical frequency of the F layer. Using a power aperture product of 1,000 sq megawatt-meter, which corresponds to a projected experiment by ESSA at Boulder, Colorado, a maximum increase in the electron temperature at the peak of the F layer of about 30% with a reduction in the electron density of about 10% is found. The time scale for achieving the density changes is predicted to be about one-half hour to an hour. (auth) (USGRDR)

51451 (AD–690545) LONG PERIOD GRAVITY AND ACOUSTIC MODES OF THE FRENCH NUCLEAR TESTS OF 1968. Tolstoy, I.; Herron, T. (Columbia Univ., Dobbs Ferry, N. Y. Hudson Labs.). Oct. 1968. Contract Nonr-266(84). 34p. (TR–163). CFSTI.

Results obtained on the Hudson Laboratories long-period microbarograph array for the French nuclear tests of 1968 are described. Through digital beam-forming techniques, it is possible to detect long-period (15 min), 600 m/sec/1 arrivals traveling both the short and long great circle paths from the South Pacific test site 300 m/sec/1. Yield estimates are obtained from the amplitudes of the short-period acoustic signals. (auth) (USGRDR)

51452 (CONF-680722) ACOUSTIC–GRAVITY WAVES IN THE ATMOSPHERE. Symposium Proceedings, Boulder, Colorado, 15–17 July 1968. Georges, T. M. (ed.) (Environmental Science Services Administration, Boulder, Colo. Advanced Research Projects Agency, Washington, D. C.). 445p. GPO $3.75.

The aim of the Symposium was to draw together specialists from the several diverse disciplines that have come to be concerned with wave motions in the neutral atmosphere. Some 48 papers were presented on generation of atmospheric waves by natural and artificial sources, propagation in the terrestrial environment, and effects in the upper atmosphere and ionosphere. Separate abstracts were prepared for seven papers, five of which are concerned with wave generation by nuclear explosions, one with hydromagnetic coupling of acoustic–gravity waves with the ionosphere, and one with gravity effects on hydromagnetic-wave propagation. (W.D.M.)

For abstracts of individual papers see: 51453–51459.

51453 (CONF-680722–, pp 1-8) GENERATION OF GRAVITY–ACOUSTIC WAVES BY NUCLEAR DETONATIONS. Knabe, W. E.; Kahalas, S. L. (Mount Auburn Research Associates, Inc., Cambridge, Mass.).

From Symposium on Acoustic–Gravity Waves in the Atmosphere, Boulder, Colo.

Various generating mechanisms are considered as sources of acoustic and gravity waves, taking into consideration nuclear detonation outputs. Such mechanisms include: shock motion, violent heating of air, turbulence, and nonlinear effects. (auth)

51454 (CONF-680722–, pp 9-24) THEORETICAL SOURCE MODELS FOR THE GENERATION OF ACOUSTIC–GRAVITY WAVES BY NUCLEAR EXPLOSIONS. Pierce, Allan D. (Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering).

From Symposium on Acoustic–Gravity Waves in the Atmosphere, Boulder, Colo.

A generally accepted source model (as regards hydrodynamic effects) for a nuclear explosion is that of an initially small high-temperature sphere of total energy E and initially of ambient density. Since the early history of the blast wave involves highly nonlinear effects, this model cannot be incorporated directly into a linear theory for the interpretation of far field microbarograms. The usual practice is for one to assume a decoupling between nonlinear effects and the combined gravitational and atmospheric effects, by selecting a linear source model with reference to computations of blast waveforms in a homogeneous atmosphere without gravity. Possible methods for incorporating source models into a linear formulation are discussed. Mass and energy point source models are compared as to their far field predictions. The two types of sources are formally equivalent when the explosion is near the ground but differ markedly as regards excitation of incompressible guided modes for above-ground explosions. The applicability of point source models is argued to be valid for the interpretation of acoustic arrivals. They may not be applicable in the interpretation of the gravity wave even when the characteristic number $(E/p_0)^{1/3}g/c^2$ is small, as the computations neglecting gravity cannot be relied on to accurately predict the tail of the blast wave. A simple calculation indicates that as much energy as E/4 may be associated with the rise of the bubble created by wave transport of mass from the center of detonation. Qualitative implications of this are explored by examination of the fully linear acoustic–gravity initial value problem. The results suggest that (insofar as the gravity wave is concerned) a linear model with a point impulsive energy source may suffice. If this is true, then the waveform amplitude should be proportional to E and the waveform shape should be independent of E. (auth)

51455 (CONF-680722–, pp 45-64) THEORETICAL CALCULATIONS OF TRAVELING IONOSPHERIC DISTURBANCES GENERATED BY LOW–ALTITUDE NUCLEAR EXPLOSIONS. Greene, J. S. Jr.; Whitaker, W. A. (Air Force Weapons Lab., Kirtland AFB, N. Mex.).

From Symposium on Acoustic–Gravity Waves in the Atmosphere, Boulder, Colo.

The Air Force Weapons Laboratory SHELL and SAP hydrodynamic computer codes were used to calculate the generation and to a limited extent the propagation of ionospheric disturbances originating from low-altitude nuclear explosions. These codes solve Newton's equations. The free-field fluid quantities of density, pressure, energy, and velocity are calculated continuously as a function of space and time. The original intention was to investigate overhead disturbance arrival times, but the calculations were continued to one hour and twenty minutes after the burst. By this time the ionosphere is disturbed 3600 km from the burst axis. The calculations show that the first perturbation in the F-layer critical frequency, even at these distances, is created by the primary acoustic shock wave traveling radially outward at about 750 m/sec. The subsequent f_0F perturbations are due to traveling disturbances with pressure–velocity relationships characteristic of long-period internal atmospheric gravity waves. These gravity waves are generated in the region of rapid temperature increase near the 120-km level. The generation processes are associated with an acceleration and fold-over of the shock waves passing through this region. (auth)

51456 (CONF-680722–, pp 69-77) PROPAGATION VELOCITY OF ACOUSTIC–GRAVITY WAVE DUE TO LARGE NUCLEAR EXPLOSION. Yamamoto, Ryozaburo (Kyoto Univ. (Japan)).

From Symposium on Acoustic–Gravity Waves in the Atmosphere, Boulder, Colo.

Distribution of propagation velocities of the primary wave A_1 and the returning one B_1 due to the Soviet nuclear explosion, October 30, 1961 is examined over the northern hemisphere, using the isochrone maps of wave arrival by Wexler and Hass [1962]. The wind effects may be excluded from the mean propagation speed of both waves, confirming that both waves have the opposite propagation direction and that there is no appreciable time change in structure of the atmosphere. Over a large part of the area analyzed, the mean speed is in the range from 275 to 350 m/sec. The values of mean speed higher than 350 m/sec over the central Pacific and lower than 275 m/sec over Arctic regions and off England are not easily explained with the observed temperature structure up to the lower stratosphere. Difference of the propagation speed between A_1 and B_1 waves gives the wind-induced increment of velocity, which exceeds 50 m/sec over Davis Strait and 20 m/sec north of the West Indies. Such wind distribution that may give these velocity increments cannot be found in the layer below the height of 25 km. (auth)

51457 (CONF-680722–, pp 79-86) ACOUSTIC WAVES IN THE IONOSPHERE FOLLOWING NUCLEAR EXPLOSIONS. Baker, Donald M. (Environmental Science Services Administration, Boulder, Colo.).

From Symposium on Acoustic–Gravity Waves in the Atmosphere, Boulder, Colo.

Following several atmospheric nuclear explosions in 1961 and 1962, wavelike disturbances were observed at 150 to 200 km above the United States. The disturbances, detected as oscillatory varia-

tions in the frequencies of radio signals reflected from the F region, had periods ranging from 5 min down to less than 1 min, with periods of about 1 min being predominant. The speed of propagation of the disturbances was about 300 m/sec. The periods, propagation speeds, and dispersion exhibited by the ionospheric disturbances are essentially the same as those observed in ground-level pressure variations (microbarograms) following the same explosions. These ionospheric disturbances are interpreted as manifestations of imperfectly ducted acoustic waves. The bulk of the acoustic-wave energy was confined to lower heights (probably below 120 km); some of the energy, however, leaked upward into the F region of the ionosphere. For one specific event (October 30, 1962) an upper limit to the energy flux at 190 km is found to be 0.5 erg cm^{-2} sec^{-1}. (auth)

51458 (CONF-680722–, pp 397-401) HYDROMAGNETIC COUPLING OF ACOUSTIC–GRAVITY WAVES WITH THE IONIZED ATMOSPHERE. Kato, S.; Reddy, C. A.; Matsushita, S. (High Altitude Observatory, Boulder, Colo.).

From Symposium on Acoustic–Gravity Waves in the Atmosphere, Boulder, Colo.

Acoustic–gravity waves give rise to disturbances in the ionization density in the ionosphere. These disturbances consist of two components. One is a duplication of the neutral gas perturbation by the gravity waves, but the other is controlled by the electrostatic field $\underline{E}_0$ and the geomagnetic field $\underline{B}_0$ in the ionosphere. The latter component (the hm component) travels with the ion velocity if the wave propagation vector is not orthogonal to $\underline{B}_0$ and with the electron velocity if the wave vector is orthogonal to $\underline{B}_0$. In the uniform medium with infinite extension, the hm component cannot be generated, but if there is a sudden change in the propagation of gravity wave or in the electric field, a conversion from the gw component to the hm component may occur. Total reflection or propagation across the equatorial electrojet of gravity wave may induce such a conversion. (auth)

51459 (CONF-680722–, pp 403-9) HYDROMAGNETIC WAVES WITH INFLUENCE OF GRAVITY. Poeverlein, H. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.).

From Symposium on Acoustic–Gravity Waves in the Atmosphere, Boulder, Colo.

The gravity force decisively affects hydromagnetic waves at the lowest frequencies, corresponding to periods of some hours or one day. A number of simplifying assumptions had to be made in deriving formulas for modified Alfvén waves and ion–acoustic waves at these frequencies. A joint motion of plasma and neutral gas due to a sufficiently high collision frequency is assumed. Different properties of the waves are obtained, depending on the ratios between g/ω (with the gravitational acceleration g and the angular frequency ω) and the two basic wave velocities (sound velocity and Alfvén velocity). The coupled-wave theory and the generalization of the theory for application to magnetospheric and ionospheric processes are briefly discussed. (auth)

51460 (RLO-2096-1) A STUDY OF MAGNETOSPHERIC SUBSTORMS IN CONJUNCTION WITH THE VELA SATELLITE DATA. Annual Progress Report. Akasofu, S.-I. (Alaska Univ., College. Geophysical Inst.). Sept. 1969. Contract AT(45-1)-2096. 48p. Dep. CFSTI.

Detailed data are given and discussed for the following geomagnetic events; (1) Sept. 19, 1965; (2) Oct. 24, 1965; (3) Oct. 25, 1965; (4) Sept. 23, 1965; (5) Oct. 2, 1965; (6) Sept. 28, 1965; and (7) Sept. 24, 1965. (M.O.W.)

51461 DEPENDENCE OF NONDEVIATIVE IONOSPHERIC ABSORPTION ON SOLAR ZENITH ANGLE AND FREQUENCY. Rai, R. K. (Univ. of Udaipur, India). Radio Sci., 4: 757-63 (Sept. 1969).

From 3rd International Symposium on Equatorial Aeronomy, Ahmedabad, India. See CONF-690214.

Results are presented of theoretical investigations of the nature of nondeviative radio-wave absorption at vertical incidence, in an isothermal ionospheric region where collisional frequency is comparable to the exploring frequency and where the recombination coefficient is not constant but is a function of height. It has been shown that in such cases the variation of nondeviative absorption with solar zenith angle and frequency may be represented by the expression: $L \propto \{(\cos \chi)^n/(\omega \pm |\omega_L|)C + n\}$ where symbols have their usual meaning. The values of n and C are such that $(2 - C) \geq n \geq 0$ and $\frac{3}{2} \geq C \geq \frac{1}{2}$. (auth)

51462 COMPARISON STUDY OF THE OCCURRENCE OF EQUATORIAL TYPE E_s AND DAYTIME BLANKETING E_s IN THE MAGNETIC EQUATORIAL ZONE. Oyinloye, J. O. (Univ. of Ibadan, Nigeria). Radio Sci., 4: 765-9(Sept. 1969).

From 3rd International Symposium on Equatorial Aeronomy, Ahmedabad, India. See CONF-690214.

A study of the occurrence frequency of equatorial E_s (E_{sq}) and daytime blanketing E_s at Ibadan (dip 6°S) and Zaria (dip 3°N) in Nigeria is presented. The period of study covers the years 1958 to 1965. Experimental results from the study reveal that E_{sq} and blanketing E_s are different phenomena and that a high incidence of E_{sq} is usually accompanied by a low incidence of blanketing E_s, and vice versa. In addition, the extent of the E_{sq} belt in Nigeria is deduced from the relative occurrence of E_{sq} and nonequatorial E_s during the daytime at Ibadan. (auth)

51463 DYNAMO CURRENTS, WINDS, AND ELECTRIC FIELDS. Matsushita, S. (National Center for Atmospheric Research, Boulder, Colo.). Radio Sci., 4: 771-80(Sept. 1969).

From 3rd International Symposium on Equatorial Aeronomy, Ahmedabad, India. See CONF-690214.

After a brief presentation of S_q and L electric current systems deduced from geomagnetic data, electric conductivities and wind models in the dynamo region are discussed. It is then shown that the solar negative-mode thermal diurnal tide and the lunar semidiurnal gravitational tide having a phase shift with altitudes produce the best fit S_q and L current systems, respectively. Distributions of electrostatic fields are computed, and electromagnetic drift speeds in the ionospheric F region are also examined. These calculated values agree well with observed results. (auth)

51464 LOCATION OF THE DIP EQUATOR AT E-LAYER ALTITUDE. Cain, Joseph C. (Goddard Space Flight Center, Greenbelt, Md.). Radio Sci., 4: 781-4(Sept. 1969).

From 3rd International Symposium on Equatorial Aeronomy, Ahmedabad, India. See CONF-690214.

The position of the magnetic dip equator at 100 km and the gradient of position with time and altitude are tabulated using the POGO (10/68), GSFC (12/66), and IGRF (10/68) geomagnetic field models. The positions agree within a few tenths of a degree with each other but differ up to 2° from older models and charts. The maximum gradients with time (0.2°/yr) and altitude (−0.3°/100 km) occur to the west of Africa. (auth)

51465 EQUATORIAL E_s AND DAYTIME BLANKETING E_s DRIFTS AT IBADAN. Oyinloye, J. O. (Univ. of Ibadan, Nigeria). Radio Sci., 4: 785-90(Sept. 1969).

From 3rd International Symposium on Equatorial Aeronomy, Ahmedabad, India.

The daytime measurements of the velocities and other fading characteristics of equatorial E_s and blanketing E_s irregularities in the frequency range 4 to 6 MHz are presented for Ibadan. The modes of signal returns by the two groups of E_s are discussed. The experimental results suggest that the equatorial E_s irregularities observed at 4 to 6 MHz at Ibadan are of a similar nature to those observed at 50 MHz at Huancayo during a weak electrojet. A tentative inference from the equatorial E_s results in that the magnitudes of equatorial E_s velocities may be independent of the relative strength of electrojet intensity. (auth)

51466 IRREGULARITIES IN THE EQUATORIAL E REGION OVER THUMBA. Prakash, Satya; Gupta, S. P.; Subbaraya, B. H. (Physical Research Lab., Ahmedabad, India). Radio Sci., 4: 791-6(Sept. 1969).

From 3rd International Symposium on Equatorial Aeronomy, Ahmedabad, India. See CONF-690214.

A rocket-borne Langmuir probe and plasma-noise probe were used to study the ionization irregularities of scale sizes 20 meters to 0.4 meter in the lower equatorial ionosphere over Thumba during the evening twilight of February 2, 1968. Ionization irregularities were observed mostly in the height range 97 to 106 km, 142 to 155 km, and around 170 km. The spectral index n was calculated for a power law of the type $E(k) = Ak^n$. In the 100-km region, irregularities with different spectral indices were found to coexist, indicating the superposition of at least two different spectra. The irregularities with spectral index of −3.0 to −3.5 are probably produced through neutral turbulence, whereas irregularities with spectral index of −1.6 to −2.0 are probably produced by electric fields. The irregularities observed near the rocket apogee are produced by the rocket itself and have a spectral index of +3.0. The actual values of these indices are likely to be more (including sign) than given by the present calculations since the detection efficiency of a Langmuir probe for the irregularities may be size-dependent. (auth)

51467 RELATION BETWEEN THE EQUATORIAL ANOMALY AND TRANS-EQUATORIAL VHF RADIO PROPAGATION. Gibson-Wilde, B. C. (University Coll. of Townsville, Queensland, Australia). Radio Sci., 4: 797-803(Sept. 1969).

From 3rd International Symposium on Equatorial Aeronomy, Ahmedabad, India. See CONF-690214.

Comparison of the occurrence of vhf radio propagation over a 6620-km transequatorial circuit between Korea and northern

Australia with the development of the equatorial anomaly in the F layer shows that the transequatorial propagation mechanism is closely related to changes in the form of the equatorial anomaly. Signal occurrences are most common when the anomaly in f_0F_2 exhibits sharp well-defined crests located fairly symmetrically on either side of the dip equator at dip angles between 20° and 30°. These crests correspond to large horizontal gradients in the F layer ionization density, which are known to be capable of refracting radio waves at frequencies well above the normal for a horizontally homogeneous F layer. It is suggested that all transequatorial vhf signal occurrences observed over this circuit can be explained in terms of an F_2F_2 propagation mode, with the ionospheric refractions occurring at the crests of the equatorial anomaly. (auth)

51468 EQUATORIAL IONOSPHERIC ANOMALY AND THE EQUATORIAL ELECTROJET. MacDougall, J. W. (Univ. of West Indies, Kingston, Jamaica). Radio Sci., 4: 805-10(Sept. 1969).

From 3rd International Symposium on Equatorial Aeronomy, Ahmedabad, India. See CONF-690214.

It is shown that for the American zone the F-region equatorial anomaly and the equatorial electrojet are highly correlated, whereas the anomaly and the S_q current system correlate poorly. A suggested explanation for the correlation is that the eastward electric field which drives the electrojet is also present in the F-region and there causes upward plasma flow. (auth)

51469 FARADAY ROTATION OF THE 136 MHz TRANSMISSION FROM THE GEOSTATIONARY SATELLITE "CANARY BIRD" OBSERVED AT NAIROBI. Hunter, A. N. (Univ. of Lancaster, Eng.). Radio Sci., 4: 811-16(Sept. 1969).

From 3rd International Symposium on Equatorial Aeronomy, Ahmedabad, India. See CONF-690214.

The 136-MHz transmissions from "Canary Bird" were recorded at Nairobi, 1.32°S, 36.8°E, 26°(dip) from June 1967 through February 1968. The receiving system used a Yagi aerial rotating 1 rev in 6 sec. Plots of diurnal variation of Faraday rotation are given for the months of July, October, November, and December 1967 and January and February 1968. These plots show general agreement with the mean diurnal variation of total electron content as determined from the traveling satellite BE-B. One important feature which is much more marked in the geostationary satellite records is a large increase in total electron content at about 2300 hours; at this time there is commonly a marked lowering of ionosphere height. This peak, which is also apparent in f_0F_2, is thought to be associated with movement of the equatorial anomaly maxima. (auth)

51470 INVESTIGATION OF THE TOTAL ELECTRON CONTENT IN THE EQUATORIAL ANOMALY OF EAST AFRICA. Hunter, A. N.; Hibberd, F.; Mulokwa, W. (Univ. of Lancaster, Eng.). Radio Sci., 4: 817-22(Sept. 1969).

From 3rd International Symposium on Equatorial Aeronomy, Ahmedabad, India. See CONF-690214.

Measurements of total electron content by Faraday fading were made at three frequencies on BE-B at Nairobi from October 10, 1954, to the present day; two passes a day are recorded. Similar measurements on one frequency only have been made at Dar es Salaam and Addis Ababa. A computer program was written, specially suitable for low-latitude stations, and computes the M values and total electron content as a function of latitude. Errors arise from reduction of the records to locate the transverse point and from approximations in the theory. However, more serious errors are due to insufficient knowledge of the effective height and inclination of the ionosphere. Comparisons of the electron content computed at Nairobi with computations made by Koster and Golton show differences in detail but agreement in general form. Many more records remain to be reduced, to which may be added results for the BE-C, but the results so far are very variable. On many occasions when an equatorial anomaly in total content is expected to show in total content, it does not appear. The expected pattern for the development of the equatorial anomaly is most apparent during the equinoxes. (auth)

51471 LOW-LATITUDE IONOSPHERIC ELECTRON CONTENT MEASUREMENTS DURING HALF A SOLAR CYCLE. de Mendonca, F.; Kantor, I. J.; Clemesha, B. R. (Comissao Nacional de Atividades Espaciais, Sao Paulo, Brazil). Radio Sci., 4: 823-8(Sept. 1969).

From 3rd International Symposium on Equatorial Aeronomy, Ahmedabad, India. See CONF-690214.

Total electron content measurements were made at São José dos Compos (23.22°S, 45.98°W) between 1963 and 1968. The 1963 measurements were made by using the differential Doppler shift technique, and from December 1964 onwards the close-spaced-frequency method was employed using the 40 and 41 MHz transmission from the BE-B and BE-C satellites. An analysis is made of the variation of electron content with local time, dip angle, season, solar activity, and magnetic activity. Special attention is given to the equatorial anomaly and the region of the Brazilian magnetic anomaly. (auth)

51472 EQUATORIAL ANOMALY DURING A PERIOD OF DECLINING SOLAR ACTIVITY. Rush, C. M.; Rush, S. V.; Lyons, L. R.; Venkateswaran, S. V. (Univ. of California, Los Angeles). Radio Sci., 4: 829-41(Sept. 1969).

From 3rd International Symposium on Equatorial Aeronomy, Ahmedabad, India. See CONF-690214.

An observational study was made of the equatorial anomaly during a period of declining solar activity. The anomaly is studied at two different longitudes, 75°W and 105°E. Data from both the topside and the bottomside of the F region are used. The topside data were obtained by the satellite Alouette 1. Seasonal and daily variations, longitude dependence, and geomagnetic storm-time distortions of the anomaly are treated. (auth)

51473 HEATING OF THE IONOSPHERE AND ATTENUATION OF THE EQUATORIAL HYDROMAGNETIC WAVES. Dubs, C. W.; Prasad, B.; Sen, H. K. (Cambridge Research Labs., Bedford, Mass.). Radio Sci., 4: 843-8(Sept. 1969).

From 3rd International Symposium on Equatorial Aeronomy, Ahmedabad, India. See CONF-690214.

Effects of the velocity dependence of collision cross sections (momentum and energy transfer in a 3-component ionospheric gas) on the transversely propagated hydromagnetic waves at the equator are studied. The ordinary mode is found to be profoundly affected, but the extraordinary mode is not. These effects should be important in estimating joule heat including mode–mode coupling and reflections in a vertically stratified ionosphere. It is also shown that the space-charge electric field due to neutral wind drag in the dynamo region of the ionosphere provides adequate energy to the electrons to compensate for their cooling by inelastic collisions with neutral molecules. (auth)

51474 RESPONSE OF THE 1000-KILOMETER IONOSPHERE TO MAGNETIC STORMS. Reddy, B. M. (National Physical Lab., New Delhi); Lakshmi, D. R.; Brace, L. H. Radio Sci., 4: 851-7(Sept. 1969).

From 3rd International Symposium on Equatorial Aeronomy, Ahmedabad, India. See CONF-690214.

Measurements of electron concentration and electron temperatures by the Langmuir probe experiment of the Explorer 22 satellite during 1966 are employed to study the response of the topside ionosphere, at 1000 km, to magnetic storms. The analysis was limited to the American longitudes (50° to 130°W) over a latitude range from 50°S to 70°N geomagnetic. The daytime response is characterized by various degrees of electron-density enhancements over the entire latitude range, with the winter high latitudes undergoing highest enhancement. The electron-temperature changes are not so unique. An attempt is made to explain some of these features qualitatively, based on thermal expansion of the upper atmosphere during storms and the "viscous drag" of the solar plasma on the magnetosphere. (auth)

51475 CONCURRENT EQUATORIAL AND HIGH-LATITUDE GEOMAGNETIC PULSATIONS. Campbell, W. H. (Environmental Science Services Administration Research Labs., Boulder, Colo.). Radio Sci., 4: 859-68(Sept. 1969).

From 3rd International Symposium on Equatorial Aeronomy, Ahmedabad, India. See CONF-690214.

Examples of various concurrent ulf field fluctuations observed at: Jicamarca (Peru), College (Alaska), and Byrd (Antarctica) are presented to demonstrate the similarity of geomagnetic micropulsations of both Pi and Pc types at equatorial latitudes. The beginning of one Pi 1 event showed as much as 10-sec difference in onset times at a world distribution of stations. The apparent arrival of the signal varied according to the geomagnetic latitudes of the observatories. Magnetospheric sources of geomagnetic pulsations may be observed with equatorial station data. (auth)

51476 VARIATION OF Pi 2 MICROPULSATION WAVEFORM WITH TIME. Orr, David (Univ. of York, Eng.). Radio Sci., 4: 869-72(Sept. 1969).

From 3rd International Symposium on Equatorial Aeronomy, Ahmedabad, India. See CONF-690214.

Pi 2 micropulsations observed "simultaneously" at two widely separated low-latitude stations, M'Bour, Senegal, in West Africa, and Makerere, Uganda, in East Africa, were compared. The variation in the waveforms was measured in terms of an average damping coefficient and the number of excursions taken for events to reach their peak amplitude. The differences in the waveforms are discussed in terms of dispersion varying with distance from the Pi 2 source and the damping coefficient varying with time. Shorter-

period activity was noted in association with some Pi 2 events and an estimate of the relative apparent phase velocity of the higher-frequency component has been made. (auth)

51477 ON DIURNAL VARIATION OF GEOMAGNETIC PULSATIONS Pc AT M'BOUR (WEST AFRICA). Barsczus, Hans G. (Centre ORSTOM, M'Bour, Senegal). Radio Sci., 4: 873-5(Sept. 1969).

From 3rd International Symposium on Equatorial Aeronomy, Ahmedabad, India. See CONF-690214.

Six years of magnetic quick-run records made at the low-latitude M'Bour Observatory have been analyzed. It was found that the frequency of occurrence of pulsations Pc 3 and 4 presents a marked diurnal variation characterized by two principal maxima, at sunrise and around local noon. The curves of occurrence are compared with the diurnal variation of the critical frequency of the ionospheric F_2 layer at Dakar. The morning maximum of pulsations corresponds to low values of f_0F_2 which contrasts with high values corresponding to the noon maximum. In conclusion the frequency of occurrence of the geomagnetic pulsations Pc does not appear to be directly related to the critical frequency of the F_2 layer. (auth)

51478 LONG AND SHORT PERIOD CHANGES IN MAGNETIC ACTIVITY AT HUANCAYO DURING THE SOLAR CYCLE. Chernosky, Edwin J. Radio Sci., 4: 876-8(Sept, 1969).

From 3rd International Symposium on Equatorial Aeronomy, Ahmedabad, India. See CONF-690214.

Forty years of geomagnetic activity data at Huancayo are evaluated in two periodicities: the hourly and the daily changes of the horizontal magnetic field intensity. Monthly means of both periodicities are affected similarly by solar activity in that they both show the characteristic semiannual variation. Although the amplitudes of the hourly changes follow solar activity changes closely, the daily changes show a "bite out" near sunspot maximum when annual means of each are compared. The "bite out" may be due to the occurrence of magnetic storm depressions of a different duration at that time. The results suggest that the slower magnetic variations at the dip equator should not be studied as a single manifestation but in periodicity bands, as micropulsations are studied. (auth)

51479 THIRD INTERNATIONAL SYMPOSIUM ON EQUATORIAL AERONOMY, AHMEDABAD, INDIA, FEBRUARY 3–10, 1969. Radio Sci., 4: 735-878(Sept. 1969). (CONF-690214).

Separate abstracts were prepared for the 19 included papers. (M.O.W.)

For abstracts of individual papers see: 51461–51478 and 51533.

51480 Pi2 PULSATIONS, THE OVAL OF THE AURORA BOREALIS, AND THE PLASMA DENSITY IN THE MAGNETOSPHERE. Troitskaya, V. A.; Fel'dshtein, Ya. I.; Shchepetnov, R. V. Dokl. Akad. Nauk SSSR, 186: 575-7(1969). (In Russian).

A Pi2 type of geomagnetic micropulsation is used to estimate plasma density. These pulsations represent a dampened Alfven wave propagated on the night side of the Earth along a force line that rests on the oval of the Aurora borealis. It turns out that the Pi2 period is related to the position of the southern limit of the oval of the Aurora borealis. A plot of the periods of the Pi2 pulsations as a function of the change in intensity of the magnetic perturbations near the hour of midnight gives a straight line for the years of 1957 and 1961. The period decreases with an increase in magnetic perturbation. The plasma density in the equatorial plane is calculated at various geocentric distances for the years of 1957 and 1961. The density increased with decreasing geocentric distance. A decrease in plasma density by a factor of 1.5 is observed with a decrease in solar activity. (TTT)

51481 WINDS AND TURBULENCE IN STRATOSPHERE, MESOSPHERE, AND IONOSPHERE. Proceedings of the NATO Advanced Study Institute, Lindau, Germany, 18 September–1 October 1966. Rawer, K. (ed.). New York, John Wiley and Sons, Inc., 1968. 426p. $18.50. (In English and French). (CONF-660969).

Separate abstracts are included for fifteen of the sixteen papers. The measurement of winds by meteors between 80 and 110 km was the subject of the paper omitted because of scope. (M.H.R.)

For abstracts of individual papers see: 51482–51496.

51482 ATMOSPHERIC STRUCTURE BETWEEN 30 AND 120 KM. Fedele, Diego; Zancla, Antonino (Ministero della Difesa Aeronautica, Rome). pp 1-33 of Winds and Turbulence in Stratosphere, Mesosphere, and Ionosphere. Rawer, K. (ed.). New York, John Wiley and Sons, Inc., 1968.

From Conference on Winds and Turbulence in Stratosphere, Mesosphere, and Ionosphere, Lindau, Germany. See CONF-660969.

After an examination of the layers in which the atmosphere is divided, effects of solar, atmospheric and terrestrial radiation are considered as well as the composition of the atmosphere up to 120 km. Winds in the upper atmosphere and predominant zonal circulation are dealt with according to new experimental data. (auth)

51483 EXPERIMENTAL METHODS IN EXPLORING THE ATMOSPHERE BETWEEN 30 KM AND 120 KM. Fedele, Diego (Ministero della Difesa Aeronautica, Rome). pp 34-51 of Winds and Turbulence in Stratosphere, Mesosphere, and Ionosphere. Rawer, K. (ed.). New York, John Wiley and Sons, Inc., 1968.

From Conference on Winds and Turbulence in Stratosphere, Mesosphere, and Ionosphere, Lindau, Germany. See CONF-660969.

A brief review of methods and techniques for exploring the upper atmosphere is presented. Beyond direct measurements using sounding rockets and gun launched probes, a large amount of indirect measurements can be obtained by means of ground-based devices: winds and temperatures from sound propagation or from meteor tracking; density and temperature from light scattering; composition from airglow and aurora. (auth)

51484 EFFECTS OF SOLAR RADIATION IN THE LOWER ATMOSPHERE. Kriester, Barbara (Free Univ., Berlin). pp 52-80 of Winds and Turbulence in Stratosphere, Mesosphere, and Ionosphere. Rawer, K. (ed.). New York, John Wiley and Sons, Inc., 1968.

From Conference on Winds and Turbulence in Stratosphere, Mesosphere, and Ionosphere, Lindau, Germany. See CONF-660969.

The main characteristics of the solar and terrestrial radiation are considered and a short insight is given into the mean heat balance of the earth–atmosphere system. Some special features of the circulation which arise through the latitudinal unbalance are treated and the mean pattern will be shown by using mean maps of constant pressure levels. (auth)

51485 STRATOSPHERIC WARMINGS. Kriester, Barbara (Free Univ., Berlin). pp 81-122 of Winds and Turbulence in Stratosphere, Mesosphere, and Ionosphere. Rawer, K. (ed.). New York, John Wiley and Sons, Inc., 1968.

From Conference on Winds and Turbulence in Stratosphere, Mesosphere, and Ionosphere, Lindau, Germany. See CONF-660969.

The different types of stratospheric warmings are classified with respect to their main characteristics. A survey is given on the stratospheric warmings which occurred since the first one was described in 1952. Connections to the tropospheric behavior and to the 26-month cycle in the stratospheric winds over the tropics are discussed and, finally, some theories about causes are considered. (auth)

51486 RELATIONS BETWEEN STRATOSPHERE AND MESOSPHERE. Shapley, A. H. (Environmental Science Services Administration, Boulder, Colo.). pp 123-42 of Winds and Turbulence in Stratosphere, Mesosphere, and Ionosphere. Rawer, K. (ed.). New York, John Wiley and Sons, Inc., 1968.

From Conference on Winds and Turbulence in Stratosphere, Mesosphere, and Ionosphere, Lindau, Germany. See CONF-660969.

Different methods for checking relationships between both atmospheric regions are discussed. The notion of a stratospheric event is defined, and the method of studying associated stratospheric and ionospheric phenomena by comparison of events is presented in more detail and with examples. The conclusion is that stratosphere–ionosphere coupling exists under certain circumstances and in the higher geographic latitudes. (auth)

51487 D-REGION PHENOMENA ASSOCIATED WITH METEOROLOGICAL INFLUENCES. Dieminger, W. (Max-Planck-Institut fuer Aeronomie, Lindau, Ger.). pp 143-77 of Winds and Turbulence in Stratosphere, Mesosphere, and Ionosphere. Rawer, K. (ed.). New York, John Wiley and Sons, Inc., 1968.

From Conference on Winds and Turbulence in Stratosphere, Mesosphere, and Ionosphere, Lindau, Germany. See CONF-660969.

The propagation of radio waves through the lower ionosphere is discussed theoretically, with special reference to absorption phenomena. Observations of absorption of radio waves show that, besides the regular diurnal and seasonal variation with the solar zenith angle there is excessive absorption on winter days in medium latitudes. This winter anomaly is ascribed to increased electron density in the lower ionosphere, caused apparently by peculiarities of the general mesospheric circulation in winter. (auth)

51488 STRUCTURE OF THE D-REGION FROM PARTIAL RADIO REFLECTION OBSERVATIONS. Dieminger, W. (Max-Planck-Institut fuer Aeronomie, Lindau, Ger.). pp 178-200 of Winds and Turbulence in Stratosphere, Mesosphere, and Ionosphere. Rawer, K. (ed.). New York, John Wiley and Sons, Inc., 1968.

From Conference on Winds and Turbulence in Stratosphere, Mesosphere, and Ionosphere, Lindau, Germany. See CONF-660969.

The partial-reflection method is based on the simultaneous measurement of the amplitude of the o and x component of partially reflected radio waves. Both the collision frequency at the lower boundary of the ionosphere and the electron density versus height can be calculated from the measurements for the region between 60 and 90 km. Approximately 80 profiles were derived in different latitudes for undisturbed conditions and during SID's and PCA's. Generally, the results agree with those obtained by other methods. (auth)

51489 A SIMPLE DESCRIPTION OF IONOSPHERIC DRIFTS IN THE E REGION AS OBTAINED BY THE FADING METHOD AT BREISACH. Harnischmacher, E.; Rawer, K. (Ionosphaeren-Institut, Breisach, Ger.). pp 242-76 of Winds and Turbulence in Stratosphere, Mesosphere, and Ionosphere. Rawer, K. (ed.). New York, John Wiley and Sons, Inc., 1968.

From Conference on Winds and Turbulence in Stratosphere, Mesosphere, and Ionosphere, Lindau, Germany. See CONF-660969.

The observations of the period 1955 through 1963 were analyzed by a special program of harmonic analysis, using only three terms of development with "variation of the constants." Results for the direction statistics are given. The seasonal influence is introduced as statistical difference with respect to the annual mean value. A strong influence of the solar declination is stated. Arranging the data after the lunar phase, a similar influence of the lunar declination is found. There exists also an important influence of the lunar phase, which is shown by diagrams of differential statistics. (auth)

51490 RESULTS OF AN EXPERIMENT CONCERNING THE FADING PATTERN. Harnischmacher, E. (Ionosphaeren-Institut, Breisach, Ger.). pp 277-97 of Winds and Turbulence in Stratosphere, Mesosphere, and Ionosphere. Rawer, K. (ed.). New York, John Wiley and Sons, Inc., 1968.

From Conference on Winds and Turbulence in Stratosphere, Mesosphere, and Ionosphere, Lindau, Germany. See CONF-660969.

A new model for explaining drift observations supposes incurved extremal lines moving and expanding (or contracting) at the same time, and with a rather short average life time. Using a simplified Monte Carlo computation technique, one obtains the statistics of indication errors; these are minimal for the central triangle, and show typical distributions for the outer ones. Comparison with observational data shows priority of imploding forms in winter, but of exploding forms in summer. This explains certain aspects of the observed statistics of the error distribution. (auth)

51491 GENERAL NATURE OF ACOUSTIC-GRAVITY WAVES. Gille, John C. (Florida State Univ., Tallahassee). pp 298-321 of Winds and Turbulence in Stratosphere, Mesosphere, and Ionosphere. Rawer, K. (ed.). New York, John Wiley and Sons, Inc., 1968.

From Conference on Winds and Turbulence in Stratosphere, Mesosphere, and Ionosphere, Lindau, Germany. See CONF 660969.

The equations governing acoustic–gravity waves in an infinite isothermal atmosphere are developed by the perturbation method. Physical insight is obtained by considering simple cases and graphical representations. From the boundary conditions between two semi-infinite atmospheres, the possibilities of boundary waves and total reflection are shown. The implications of total reflection for ducting in the atmosphere are explored qualitatively. (auth)

51492 ACOUSTIC-GRAVITY WAVE DUCTING IN THE ATMOSPHERE BY VERTICAL TEMPERATURE STRUCTURE. Gille, John C. (Florida State Univ., Tallahassee). pp 322-55 of Winds and Turbulence in Stratosphere, Mesosphere, and Ionosphere. Rawer, K. (ed.). New York, John Wiley and Sons, Inc., 1968.

From Conference on Winds and Turbulence in Stratosphere, Mesosphere, and Ionosphere, Lindau, Germany. See CONF-660969.

Pfeffer's matrix method of calculating wave propagation in non-isothermal atmospheres is described. Both the fundamental (a Lamb wave) and solutions having nodes in the vertical are predicted. The results are discussed; particular attention is given to the requirement that any atmosphere must include the mesopause temperature minimum to yield realistic results. Radiative and photochemical effects are touched briefly. (auth)

51493 GRAVITY WAVES IN THE PRESENCE OF WIND SHEARS AND DISSIPATIVE PROCESSES. Hines, C. O. (Univ. of Chicago). pp 356-63 of Winds and Turbulence in Stratosphere, Mesosphere, and Ionosphere. Rawer, K. (ed.). New York, John Wiley and Sons, Inc., 1968.

From Conference on Winds and Turbulence in Stratosphere, Mesosphere, and Ionosphere, Lindau, Germany. See CONF-660969.

The propagation of gravity waves through the mesosphere is seriously affected by anisotropic filtering due to the wind profile. A second filtering influence is imposed by dissipative processes. (auth)

51494 APPLICATIONS OF GRAVITY-WAVE THEORY TO UPPER ATMOSPHERIC STUDIES. Hines, C. O. (Univ. of Chicago). pp 364-70 of Winds and Turbulence in Stratosphere, Mesosphere, and Ionosphere. Rawer, K. (ed.). New York, John Wiley and Sons, Inc., 1968.

From Conference on Winds and Turbulence in Stratosphere, Mesosphere, and Ionosphere, Lindau, Germany. See CONF-660969.

Arguments are given that filtered gravity waves may explain the wind structure near the base of the thermosphere, ionospheric drifts, and traveling ionospheric disturbances. (auth)

51495 THE GENERAL THEORY OF TURBULENCE: TURBULENCE IN THE ATMOSPHERE. Bolgiano, R. Jr. (Cornell Univ., Ithaca, N. Y.). pp 371-400 of Winds and Turbulence in Stratosphere, Mesosphere, and Ionosphere. Rawer, K. (ed.). New York, John Wiley and Sons, Inc., 1968.

From Conference on Winds and Turbulence in Stratosphere, Mesosphere, and Ionosphere, Lindau, Germany. See CONF-660969.

The theory of turbulence is developed, including spectral representation thereof, both in an incompressible fluid and in the stably stratified atmosphere. The roles of mean shear and of density (temperature) stratification in modifying structure are considered in particular, not only of the turbulence itself but also of inhomogeneities of the radio refractive index. It is concluded that the first-order effect of shear is to produce a highly anisotropic spectrum in which the high-wavenumber components are aligned closely with the direction of shear. It is further determined that, if a buoyancy subrange occurs, the refractivity spectrum within this subrange will most probably be inversed proportional to the first power of wave number magnitude. (auth)

51496 DIFFERENT TYPES OF TURBULENCE. Misme, P. (CNET, Paris). pp 401-13 of Winds and Turbulence in Stratosphere, Mesosphere, and Ionosphere. Rawer, K. (ed.). New York, John Wiley and Sons, Inc., 1968. (In French).

From Conference on Winds and Turbulence in Stratosphere, Mesosphere, and Ionosphere, Lindau, Germany. See CONF-660969.

The different types of turbulence velocity studies separately are distinguished: whirls of Bénard, convection, atmospheric layers, and irregular turbulence of Obukov. The radioelectric turbulence, which is determined by the law of the turbulence velocity, is discussed. The role of the turbulence energy is shown and one supposes that this energy is obtained at the beginning of a radiative atmosphere. The data received agree with the experiment. (auth)

51497 PLASMA INJECTION INTO THE MAGNETOSPHERE DURING THE MAIN PHASE OF A MAGNETIC STORM. Ivanov, K. G. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 9: 115-17(1969).

Translated from Geomagn. Aeron., 9: 147(1969).

A brief theoretical analysis of the ring current from plasma injection into the magnetosphere is presented. Energy–magnetic pressure relationships are given. (M.O.W.)

51498 USE OF MATHEMATICAL METHODS FOR FORECASTING f_0F_2. Chernyshev, O. V. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.) 9: 123-4(1969).

Translated from Geomagn. Aeron., 9: 154-5(1969).

A method for describing mathematically the space–time variations of monthly median f_0F_2 values is discussed. Various coefficient determinations for the infinite series representation are discussed for different parameters. (M.O.W.)

51499 N(h) PARAMETERS AND THE TEMPERATURE OF THE F-REGION AT THE TIME OF A STRONG MAGNETIC-

IONOSPHERIC STORM DURING THE IQSY. Shapiro, B. S.; Shashun'kina, V. M. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 9: 124-7(1969).

Translated from Geomagn. Aeron., 9: 156-8(1969).

The strongest magnetic–ionospheric disturbance with a sudden commencement was recorded during the IQSY on June 15 through 17, 1965. The N(h) profiles for each hour of the day were computed by the integral method for this disturbance. The main parameters of these profiles at the time of the storm are analyzed. (M.O.W.)

51500 IONOSPHERIC EFFECTS OF THE SOLAR PROTON FLARE OF JUNE 7, 1966. Driatskii, V. M. Geomagn. Aeron. (USSR) (Engl. Transl.), 9: 44-8(1969).

Translated from Geomagn. Aeron., 9: 56-61(1969).

A morphological description is given of a polar-cap absorption event that started after the proton flare of July 7, 1966. The latitudinal distribution of absorption is examined and the magnetic proton cutoff threshold is estimated. Data are presented on the variation in the character of absorption distribution with the appearance of geomagnetic disturbance. (auth)

51501 ELECTRIC PROPERTIES OF THE IONOSPHERE IN A VARIABLE FIELD. Astrakhantsev, G. V.; Zhuravleva, R. B. (Inst. of Geophysics, Kiev). Geomagn. Aeron. (USSR) (Engl. Transl.), 9: 49-54(1969).

Translated from Geomagn. Aeron., 9: 62-8(1969).

The values of the components of the tensor of electric conductivity and the dielectric constant of the ionospheric plasma are computed for a specific model in the quasi-hydrodynamic approximation in the region of ion and electron resonances. An effective parameter describing particle collision is introduced and analytical expressions are obtained which are convenient for the analysis of the frequency-dependence of the electric conductivity and dielectric constant of the plasma. (auth)

51502 ROCKET INVESTIGATIONS OF IONOSPHERIC CURRENTS AT MIDDLE AND LOW LATITUDES. Pogrebnoi, V. N.; Fatkullin, M. N. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 9: 55-9(1969).

Translated from Geomagn. Aeron., 9: 69-74(1969).

Experimental data on ionospheric currents are analyzed. It is found that there are no currents in the D region and above the E region. The conclusion is reached that currents flowing in the E layer are entirely determined by variations of the S_q type observed at earth level. Several structural features of the current layer in the region of the magnetic equator are determined. (auth)

51503 REGARDING IONOSPHERIC MEASUREMENTS BY THE METHOD OF INCOHERENT RADIO WAVE SCATTERING. Misyura, V. A.; Tkachev, G. N.; Yerokhin, Yu. G.; Ivanov, V. I.; Nisnevich, N. I.; Borodin, N. M. Geomagn. Aeron. (USSR) (Engl. Transl.), 9: 60-3(1969).

Translated from Geomagn. Aeron., 9: 75-9(1969).

A method of measuring electron density and ion and electron temperature is described and the results are reported. The difficulties of interpreting the frequency spectra of incoherently scattered signals, resulting from the nonmonochromatic nature of the emitted signals, are discussed. (auth)

51504 HEIGHT DEPENDENCE OF THE DRIFT IN INHOMOGENEITIES IN THE IONOSPHERE. Zelenkov, V. E.; Koryakin, A. G. (Siberian Physical-Technical Inst., USSR). Geomagn. Aeron. (USSR) (Engl. Transl.), 9: 64-8(1969).

Translated from Geomagn. Aeron., 9: 80-6(1969).

The results of drift velocity measurements at Tomsk, Alma-Ata, and Ashkhabad from 1957 to 1966 are discussed. Investigations of the seasonal diurnal drift velocity pattern showed that a semidiurnal component is characteristic for the E1 and E2 layers and for the lower part of the F layer. A 24-hour periodicity is observed at heights greater than 250 to 270 km. No significant dependence of drift velocity on solar activity was found. (auth)

51505 DETERMINATION OF THE PARAMETERS OF IONIZED LAYERS FROM IONOSPHERIC DATA. Osipov, N. K.; Pivovarova, N. B.; Timoshenko, L. F. (Moscow State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.), 9: 69-75(1969).

Translated from Geomagn. Aeron., 9: 87-94(1969).

The properties of the coefficient of reflection of an electromagnetic wave from a thin ionization layer are investigated. A method is described for determining the characteristics of layers in the E_s region. It is demonstrated that the frequency dependence of the amplitude of a reflected signal permits conclusions to be made on the thickness of an ionospheric layer and on the collision frequency with neutral atoms. (auth)

51506 POSSIBILITY OF DETERMINING THE SLOPES OF THE IONOSPHERE BY OBLIQUE SOUNDING. Tushentsova, I. A. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 9: 82-5(1969).

Translated from Geomagn. Aeron., 9: 103-7(1969).

The change in the form of distance–frequency characteristics of oblique sounding (OS) in a horizontally inhomogeneous ionosphere is examined. A formula is obtained for determining from OS data the equivalent angle of inclination of an ionospheric layer for the model of a plane earth and ionosphere. The angles of inclination computed from OS data are compared with corresponding values obtained from vertical sounding (VS). (auth)

51507 DIURNAL ENERGY PATTERN OF AURORAL ELECTRONS. Zaytseva, S. A.; Iviiev, D. Ya.; Pudovkin, M. I. (Leningrad State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.), 9: 86-8(1969).

Translated from Geomagn. Aeron., 9: 108-11(1969).

The change in the height of the layer of maximum ionization and in the energy of injected electrons is computed for the time interval from 18 to 06h LT. The energy of auroral electrons is found to increase monotonically by one order of magnitude in the time interval in question. (auth)

51508 SOME CHARACTERISTICS OF PLASMA MOTION IN THE EARTH'S MAGNETOSPHERE. Samokhin, M. V. (Inst. of Radio Engineering, Mosocw). Geomagn. Aeron. (USSR) (Engl. Transl.), 9: 12-17(1969).

Translated from Geomagn. Aeron., 9: 16-22(1969).

The motion of matter in the earth's magnetosphere is investigated. It is demonstrated that eddy flow appears when flow takes place from the free boundary inside the magnetosphere and the velocity of matter changes sign upon crossing the head point. The structure of eddy flow in an incompressible fluid with a cylindrical and spherical forbidden zone is investigated as an example. Quasi-hydrodynamic flow in the neighborhood of the head point is considered. (auth)

51509 THEORETICAL SHAPE OF THE MAGNETOSPHERE BOUNDARY WITH ALLOWANCE FOR THE INCLINATION OF THE GEOMAGNETIC DIPOLE TOWARD THE GEOGRAPHIC AXIS AND FOR THE NONDIPOLE PART OF THE GEOMAGNETIC FIELD. Rudneva, N. M. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 9: 18-22(1969).

Translated from Geomagn. Aeron., 9: 23-8(1969).

The magnetosphere boundary is computed with allowance for the inclination and the nondipole part of the geomagnetic field. The magnetosphere boundary changes little under the influence of the nondipole part of the geomagnetic field. The asymmetry of the magnetosphere on the day side must create the asymmetry of the tail. (auth)

51510 UPPER ATMOSPHERE AS A REGULATOR OF GEOMAGNETIC STORMS, SUBSTORMS, AND AURORAS. Krasovskii, V. I. (Inst. of Atmospheric Physics, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 9: 23-31(1969).

Translated from Geomagn. Aeron., 9: 29-40(1969).

Geomagnetic storms, substorms, and auroras are functions of two groups of independent or slightly dependent processes in the solar wind and the upper atmosphere of the earth. Spectroscopic investigations of auroral intensity attest to the fact that electrons and protons that excite auroras are frequently injected separately into the atmosphere in neighboring regions. Electrons giving rise to auroras freely penetrate into the ionospheric E region. But protons have generally an energy of ~500 eV and, therefore, they cannot penetrate to the same depth. The appearance of intense auroras and substorms requires good electric conductivity between the proton and electron injection zones. But this electric conductivity can be ensured only in the presence of a "wake" wind, when the ionized atmosphere is transported from the electron injection regions into the area beneath the proton injection regions. A comparison of planetary auroral energies with the magnitude of the electrojet in the auroral zone indicates that they can be coordinated only on the assumption that there are many systems of small electrojets of various directions that cannot be resolved by ground stations that record only the total effect. The decay of the ring current cannot be explained by the charge exchange of protons in the exosphere with atomic hydrogen. It is possible that the decay of the ring current occurs as a result of the internal circulation of the magnetospheric plasma, responsible for the ring current, between the internal zones and the boundary of the magnetosphere. (auth)

51511 POLAR-TYPE ABSORPTION IN THE MIDDLE-LATITUDE IONOSPHERE DURING THE GLOBAL GEOMAGNETIC STORM OF MAY 26, 1967. Belikovich, V. V.; Benediktov, E. A.;

Grishkevich, L. V. (Gorky State Univ., USSR). Geomagn. Aeron. (USSR) (Engl. Transl.), 9: 139-40(1969).
Translated from Geomagn. Aeron., 9: 172-3(1969).

Strong ionospheric disturbances accompanied by auroral-type radio wave absorption in the ionosphere were observed at Gor'kii during the global geomagnetic storm of May 26, 1967. The state of the ionosphere was observed by the AIS ionosonde. Radio wave absorption measurements were made at 24.6, 13, and 8.9 MHz. (M.O.W.)

51512 FORM OF THE EQUIVALENT CURRENT SYSTEM OF POLAR GEOMAGNETIC DISTURBANCES. Afonina, R. G.; Fel'dshtein, Ya. I. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 9: 142-4(1969).
Translated from Geomagn. Aeron., 9: 176-8(1969).

To judge how representative the global representation of the field of a polar magnetic disturbance in the form of a current system is, the direction of the disturbance vector at $\phi \sim 70°$ at 20–22h LT and at $\phi \sim 75°$ at 09-10 h LT, as well as the rotation of this vector at $\phi \sim 65°$ upon transition from a positive baylike disturbance to a negative one in winter are investigated. Data taken from different stations are presented and discussed. (M.O.W.)

51513 MORPHOLOGY OF THE INITIAL PHASE OF MAGNETIC STORMS AND SUDDEN IMPULSES. Fainberg, E. B. (Inst. of the Physics of the Earth and Atmosphere, Ashkhabad, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.), 9: 145-7(1969).
Translated from Geomagn. Aeron., 9: 179-80(1969).

Some problems of the morphology of sudden commencements that are of interest from the viewpoint of their applicability to deep soundings are examined. More than 100 sudden commencements with a steep leading front and a clear stable part of a duration of 0.7 to 3 hours, recorded at various points in Turkmenia from 1958 to 1967 were used. (M.O.W.)

51514 VARIATION IN THE FREQUENCY OF APPEARANCE OF GEOMAGNETIC PULSATIONS WITH THE LEVEL OF GEOMAGNETIC AND SOLAR ACTIVITY. Gogatishvili, Ya. M. (Inst. of Geophysics, Tbilish, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.), 9: 147-8(1969).
Translated from Geomagn. Aeron., 9: 181-2(1969).

A diagram is given that shows the distribution of the mean monthly frequencies of appearance of pulsations v_i (average monthly number of hours covered by pulsations in percent) and the corresponding values of the H component of the geomagnetic field. (M.O.W.)

51515 PROPAGATION OF HYDROMAGNETIC WAVES, GUIDED BY THE MAGNETIC FIELD, THROUGH THE LOWER LAYERS OF THE IONOSPHERE. Van'yan, L. L.; Abramov, L. A. (Inst. of Terrestrial Physics, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 9: 121-2(1969).
Translated from Geomagn. Aeron., 9: 154(1969).

An idealized model is examined where the half-space filled with an ideal cold plasma with a wave constant k (magnetosphere) is bounded from below by an isotropic conducting layer of thickness h_1 with a wave constant k_1 (lower ionosphere), an insulating layer of thickness h_2 with a wave constant k_2 (atmosphere), and a conducting half-space with a wave constant k_3 (Earth). Considering the remoteness of the source, the propagation along the z axis of a plane homogeneous wave with electromagnetic components E_x and b_y is investigated. (M.O.W.)

51516 ION COMPOSITION AND IONOSPHERIC REACTION COEFFICIENTS AT HEIGHTS OF 140 TO 200 km IN THE EQUATORIAL IONOSPHERE. Goncharov, L. P.; Koshelev, V. V.; Shchepkin, L. A. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 9: 127-9(1969).
Translated from Geomagn. Aeron., 9: 159-60(1969).

The coefficients of the rates of individual reactions and O^+, O_2^+, and NO^+ concentrations, obtained from a numerical simulation of a system of four continuity equations for electrons and ions on an analog computer are examined. (M.O.W.)

51517 CHARACTERISTICS OF THE VERTICAL DISTRIBUTION OF MOLECULAR ION CONCENTRATION IN THE PRESENCE OF A DOUBLE IONIZATION MAXIMUM. Shchepkin, L. A. (Siberian Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Irkutsk, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.), 9: 129-30(1969).
Translated from Geomagn. Aeron., 9: 161(1969).

Data are schematically illustrated for $n_2^+(h)$ and N(h). The relationships p(h), W(h), $x_m(h)$ (dash), x(h), and $n_2^+(h)$ and N(h) are illustrated also on the same height scale. (M.O.W.)

51518 DETERMINATION OF ELECTRON FLUX PARAMETERS FROM IONOSPHERIC DATA. Osipov, N. K.; Pivovarov, N. B.; Timoshenko, L. F.; Chiryayev, A. G. Geomagn. Aeron. (USSR) (Engl. Transl.), 9: 130-2(1969).
Translated from Geomagn. Aeron., 9: 162-4(1969).

A method is discussed for determining by an ionosonde the collision frequency of electrons with neutral molecules in the E_s region and the half-thickness of the layer a, and the possibility is mentioned of computing from these values some electron flux parameters, such as the form of the spectrum, the average energy of the electron flux, and its intensity. (M.O.W.)

51519 DIURNAL PATTERNS OF THE SPORADIC E-LAYER AND OF THE WIND IN THE IONOSPHERE. Korsunova, L. P. (Siberian Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Irkutsk, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.), 9: 133-5(1969).
Translated from Geomagn. Aeron., 9: 165-7(1969).

An experimental study was made of the influence of the diurnal wind variations in the E-region on E_s formation. The results of vertical soundings on an AIS and simultaneous records of the drift of small-scale inhomogeneities at Irkutsk are used. (M.O.W.)

51520 PROPAGATION OF SHORT RADIO WAVES VIA THE E_s LAYER. Ashkaliev, Ya. F. (Academy of Sciences, Alma-Ata, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.), 9: 135-6 (1969).
Translated from Geomagn. Aeron., 9: 168(1969).

The results of 2-year observations on short-wave propagation through the E_s layer on three links extending for 1000 km (16,170 MHz), 1400 km (18,340 MHz), and 1700 km (16,170 MHz) are reported. Cases were selected when the operating frequency exceeded the MUF of the F2 layer. Field intensity was measured regularly from 20 to 10 h LT. (M.O.W.)

51521 THEORY OF PLASMA CONCENTRATION DETERMINATION FROM THE DISPERSION OF HYDROMAGNETIC WHISTLERS. Gul'yei'mi, A. V. (Inst. of Terrestrial Physics, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 9: 136-8 (1969).
Translated from Geomagn. Aeron., 9: 169-71(1969).

The technique for plasma concentration measurements is described. Measurements on OGO-A showed that He^+ concentration is fairly high in the distance regions of the magnetopause: $\epsilon = 0.01$. Other data taken from the wave propagation are described. (M.O.W.)

51522 NITROGEN, OXYGEN, AND AIR EMISSION SPECTRA EXCITED BY FAST ELECTRONS IN THE INFRARED REGION OF THE SPECTRUM AND THEIR COMPARISON WITH AURORAL SPECTRA. Koval, A. G.; Koppe, V. T.; Gristyna, V. V.; Fogel, Ya. M. (Gorky-Kharkov State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.), 9: 89-94(1969).
Translated from Geomagn. Aeron., 9: 112-19(1969).

The nitrogen, oxygen, and air spectra at wavelengths 7000 to 11,500 Å, excited by electrons with E = 13 keV at gas pressures of 2×10^{-2} and 5×10^{-4} mm Hg, are investigated. The nitrogen spectrum was studied for excitation by electrons with energies 13 keV and 150 eV. The intensity distribution in the Meinel system of the N_2^+ ion and in the first positive system of the N_2 molecule differs in nitrogen spectra excited by fast and slow electrons. According to the relative intensity of many emissions, the nitrogen spectrum excited by electrons with E = 150 eV is more similar to the auroral spectrum than the spectrum excited by electrons with E = 13 keV. (auth)

51523 INSTABILITY PHENOMENA OF THE MAGNETOSPHERE. Kennel, Charles F. (Univ. of California, Los Angeles). pp 171-98 of Plasma Instabilities in Astrophysics. Wentzel, Donat G.; Tidman, Derek A. (eds.). New York, Gordon and Breach, Science Publishers, Inc., 1969.
From International Conference on Plasma Instabilities in Astrophysics, Pacific Grove, Calif. See CONF-681042.

Whistler-mode turbulence and its relation to the loss of high-energy electrons from the Van Allen belts are discussed. The nonlinear electron pitch-angle diffusion caused by whistlers is discussed. (M.O.W.)

51524 OBSERVATIONS ON THE MICROSTRUCTURE OF THE EARTH'S BOW SHOCK. Fredricks, R. W. (TRW Systems, Redondo Beach, Calif.); Coleman, P. J. Jr. pp 199-228 of Plasma Instabilities in Astrophysics. Wentzel, Donat G.; Tidman, Derek A. (eds.). New York, Gordon and Breach, Science Publishers, Inc., 1969.
From International Conference on Plasma Instabilities in Astrophysics, Pacific Grove, Calif. See CONF-681042.

Recent observations are presented of fluctuating electric fields and their apparent relationship to the MHD shock structure as defined by a low-frequency fluxgate magnetometer; both instruments were aboard OGO-5. (M.O.W.)

51525 MODEL OF SHOCK WAVE IN A SOLAR WIND PLASMA. Galeev, A. A.; Sagdeev, R. Z. (Inst. of Nuclear Physics, Novosibirsk, USSR). Zh. Eksp. Teor. Fiz., 57: 1047-53(July 1969). (In Russian).

A model of a collisionless shock wave in a solar wind plasma is considered. Energy dissipation of the directed motion of the plasma in the front of the shock wave is due to development of hose instability. For weak shock waves instability development can be described within the framework of the quasi-linear theory. The velocity of the shock wave is between the velocities of sound in the one-dimensional and three-dimensional hydrodynamic models. The front width is of the order of the ion Larmor radius. (auth)

51526 EFFECT OF MAGNETIC DECLINATION ON THE HEIGHT OF THE TOP OF THE F2 IONOSPHERIC LAYER. Eyfrig, Rudolf (Fernmeldetechn. Zentralamt DBP, Darmstadt, Ger.). Compt. Rned., Ser. B, 269: 97-100(July 16, 1969). (In French).

An attempt is made to verify whether the variations of F2-layer altitudes show pecularities that are consistent with the idea of ambipolar scattering of a plasma subject to the effect of a magnetic field. The diurnal variations during the equinoxes of 1964 and 1965 are shown for nine stations of western declination and eight stations of eastern declination, all located in the southern hemisphere. The general relation found in the curve is verified for other months and for different pairs of stations. (J.F.P.)

51527 TWO-DIMENSIONAL NONSTATIONARY WIND FIELD IN IONOSPHERE. Sharikadze, D. V.; Khantadze, A. G. (Tbilissi State Univ., USSR). Izv. Akad. Nauk SSSR, Fiz. Atmos. Okeana, 5: 957-61(Sept. 1969). (In Russian).

A nonstationary problem of two-dimensional wind field for a turbulent electric-conducting ionosphere (at 80 to 110 km) was resolved, using solutions for magnetohydrodynamic equations. (R.V.J.)

51528 SIMPLIFIED METHOD FOR CALCULATING AURORAL ABSORPTION FOR DISTANCES OF OVER 4000 Km. Vladimirov, Vladimir. Telecommun. J., 36: 175-80(Apr. 1969).

Auroral absorption is bound up with the aurora borealis zone and geomagnetic field. Calculations of the additional attenuation resulting from auroral absorption for distances of over 4000 km have been based on the so-called Blue Booklets. A simplified method for distances of over 4000 km was worked out on the basis of a new presentation. It requires marking the reception and transmission points of the circuit on a tranparent auroral absorption map of the world and finding the great circle passing through the two points marked. This is the path of the link. If the path of the link does not intersect any curve on the auroral absorption map at two points, read the maximum value of the index of this absorption K_α along the path. If the path intersects any curve at two points, split it into two parts. The index is obtained by a summing procedure. From the index K_α and the frequency used, the corresponding absorption may be determined on the graph. (auth)

51529 INTERNATIONAL SATELLITE FOR IONOSPHERIC STUDIES: ISIS-1. Telecommun. J., 36: 155-6(Apr. 1969).

The Canadian-built ISIS-I was launched on January 30, 1969. The topside satellite sounder technique, used in the series of which ISIS-I is a part, is the only one known that can provide worldwide electron-density profiles synoptically above the height of maximum electron density of the ionosphere. It carries five Canadian and five United States experiments. The experiments are a swept high-frequency sounder to probe the ionosphere over great distances; a fixed-frequency sounder to probe the ionosphere at six specific frequencies; a radio-noise experiment to measure ionospheric and extra-terrestrial radio noise in the outer atmosphere; a special radio receiver for measuring the vlf signals generated by lightning flashes and other natural phenomena; a cylindrical electrostatic probe to measure the temperature and concentrations of electrons near the spacecraft; energetic particle detectors to provide data which will aid in the understanding of the mechanism of production and control of the particles of the outer radiation zone which sometimes precipitate into the atmosphere, the problem of entry into the Earth's magnetic field of solar and other particles, and the general distortions in the Earth's magnetosphere from its interaction with the solar wind; an ion mass spectrometer to identify positively charged particles in the vicinity of the satellite; a 7.5-cm spherical electrostatic probe, fitted to the end of a boom that projects from the main body of the satellite, to measure the temperature numbers and density of positively charged ions; a radio beacon whose transmissions will give information about ionospheric structure and irregularities; and a detector of lower-energy particles such as the electrons that precipitate out of the upper atmosphere and cause visual auroral displays. (BBB)

51530 POLARISATION OF WAVES REFLECTED FROM THE IONOSPHERE. Knight, P. (BBC Research Dept., Surrey, Eng.). Electron. Lett., 5: 389-90(Aug. 21, 1969).

The effect of electron collisions on the polarization of waves reflected from the ionosphere is calculated by an iteration procedure and shown to be relatively small at night for both normal and oblique incidence, at frequencies above 0.5 MHz. (auth) (UK)

51531 THEORETICAL AND EXPERIMENTAL STUDIES OF THE INTERACTION BETWEEN COLLISIONLESS PLASMAS AND ELECTROMAGNETIC FIELDS. Cohen, Leonard George. Providence, Brown Univ., 1968. 178p.

Thesis.

Two model problems relating to the steady-state interaction between the collisionless solar wind and the Earth's magnetic field were solved. The first problem involved the calculation of the trajectories for a single charged particle moving in a monopole magnetic field. The trace of the particle trajectories at their inner turning point was compared to Hurley's (4) two-dimensional magnetocylinder. The results indicated how the collective properties of a plasma allow particles to penetrate further into a magnetic field than they would if they moved alone. The second problem related to the structure of the boundary layer, or magnetopause, separating a magnetic field from a collisionless plasma. A model experiment was set up to simulate the steady-state collisionless Sun–Earth interaction in the laboratory. A three-grid electrostatic cesium ion accelerator neutralized with a thoriated tungsten filament was inserted into an evacuated plasma wind tunnel and served as the steady source of collisionless plasma wind. Properties of the free stream were controlled through the bias voltages applied to the three grids and the electron emitter. Mobile probes were inserted into the plasma and three-dimensional internal measurements were made. A cylindrical Langmuir probe was used to measure ion flux. A particle flux probe, patterned after a Faraday cup, was calibrated against the Langmuir probe and was used to measure the angular divergence of the beam as well as the components of ion and electron flux directed along the axis of the plasma wind tunnel. Faraday cup measurements, made with a permanent magnet inserted into the freestream, indicated the existence of a critical ion density, $2.42 \times 10^7 < n_{min} < 1.29 \times 10^8$ ions/cm^3, which, if exceeded led to a detached magnetic boundary similar to the Earth's magnetosphere. When the ion density was less than n_{min} internal electric fields due to charge separation were insufficient to affect ion trajectories. Ion motion was unperturbed by the magnetic field because the cesium ion Larmor radius was large even when compared to the width of the plasma wind tunnel. (Diss. Abstr.)

51532 RADIATION IN THE ATMOSPHERE. Kondrat'ev, K. Ya. International Geophysics Series. Volume 12. New York, Academic Press Inc., 1969. 924p. $39.00; 364s.

This monograph includes the most recent experimental investigations in radiative transfer in the atmosphere. Numerous problems are considered based on both fundamental spectroscopic information about the atmosphere and experimental studies of the solar and terrestrial radiation. These studies are made with high resolution spectrometers, lasers, and high-speed computers. Up-to-date theoretical considerations are introduced and discussed in detail. The theoretical results are correlated with experimental data. (W.D.M.)

51533 IONOSPHERIC ABSORPTION OF RADIO WAVES DURING SUNRISE AND SUNSET HOURS. Rai, R. K. (Univ. of Udaipur, India). Radio Sci., 4: 751-5(Sept. 1969).

From 3rd International Symposium on Equatorial Aeronomy, Ahmedabad, India. See CONF-690214.

The variation of nondeviative absorption of radio waves in the ionosphere with solar zenith angle was studied at different spot frequencies. The experimental results suggest that the theoretical expression for the nondeviative absorption in the morning and evening hours should contain a constant absorption term along with the term dependent on the solar zenith angle. In the present communication it has been shown that the constant absorption term is present throughout the day, but its effect is not apparent toward noon hours, and at these hours the experimentally observed values of absorption at a fixed frequency appear to be a function of solar zenith angle only. The probable origin of the constant absorption term has been discussed. (auth)

Low-Temperature Physics

Refer also to abstract 50003.

51534 (CERN-69-25) SUPERCONDUCTING SOLENOID COOLED BY FORCED CIRCULATION OF SUPERCRITICAL HE-

LIUM. Morpurgo, M. (European Organization for Nuclear Research, Geneva (Switzerland)). Sept. 22, 1969. 12p. Dep. CFSTI (U. S. Sales Only).

A superconducting coil wound with a hollow cylinder and cooled with a forced circulation of supercritical helium is described. The coil weighs approximately 600 kg and produces a field of 50 kG in a bore of 28 cm. The main design criteria and some results obtained from the coil operation are described. (W.H.K.)

51535 (COO-1569-39) SUPERCONDUCTING FLUCTUATION ROUNDING OF THE RESISTIVE TRANSITION OF $Nb_{.88}Ti_{.12}N$ FILMS. Goldman, A. M.; Schaer, F. M.; Toth, L. E.; Zbasnik, J. (Minnesota Univ., Minneapolis). [1969]. Contract AT(11-1)-1569. 14p. Dep. CFSTI.

A detailed study of the resistive transition of $Nb_{.88}Ti_{.12}N$ films was performed from 10 to 50°K to test the theory of superconducting fluctuations. A crucial prediction of this theory is a change in the temperature dependence of the resistance corresponding to a change in the ratio of the film thickness to the temperature-dependent coherence length from $d/\xi(T) > 3$ to $d/\xi(T) < 3$. Evidence of observation of this transition is presented. The value of the Aslamazov–Larkin parameter obtained from the three-dimensional region ($d/\xi > 3$) is about $\frac{1}{3}$ the value computed from the normal sheet resistance of the film. A remarkable feature of the transition is that the superconducting fluctuations possibly affect the resistivity at temperatures as high as 33°K. (auth)

51536 (ORO-2570-13) FINAL REPORT [ON COLUMBIUM–HYDROGEN AND COLUMBIUM–OXYGEN SYSTEMS AND TYPE-II SUPERCONDUCTORS]. Haden, C. R. (Oklahoma Univ., Norman. Coll. of Engineering). Nov. 1968. Contract AT(40-1)-2570. 21p. Dep. CFSTI.

Work accomplished on Nb–H and Nb–O systems is very briefly reviewed; no new data are presented. Microwave loss measurements in In–Sn type-II superconductors were used to study the effectiveness of defects in establishing flux-trapping centers. The In content was varied from 3 to 13 at. %. Annealing experiments were done on the 3 at. % In sample. The results indicate that structural deformities are the dominant source of flux-trapping sites, and that contributions from the (In) impurities are negligible. (D.L.C.)

51537 SURFACE NUCLEATION AT ABRADED SUPERCONDUCTOR SURFACES. Hill, D. C.; Kohr, J. G.; Rose, R. M. (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. Lett., 23: 764-5(Oct. 6, 1969).

Recent experiments described in the literature show that surface abrasion results in the persistence of superconductivity at enhanced magnetic fields. The suggestion has been made that the abrasion alters the boundary conditions at the superconductor surface, thus raising the surface nucleation field. Results presented here on In–0.7% Bi alloy foils show that this behavior is not related to conditions at the specimen boundary, but rather to the presence of a layer of severely deformed material. (auth)

51538 SPECIFIC HEAT OF ^3He–^4He MIXTURES VERY NEAR THE λ LINE. Gasparini, F.; Moldover, M. R. (Univ. of Minnesota, Minneapolis). Phys. Rev. Lett., 23: 749-52(Oct. 6, 1969).

The specific heats of liquid ^4He and four ^3He–^4He mixtures under their saturated vapor pressure were measured at temperatures very close to the λ temperature of each mixture. The specific heat of mixtures with large ^3He concentration is clearly cusped at the λ line. It approaches a finite maximum with infinite slope. This supports the conjecture that the specific heat of ^3He–^4He mixtures at constant chemical potential becomes infinite at the λ line at all ^3He concentrations. (auth)

51539 SUPERCONDUCTIVITY. VOLUME I. Proceedings of the Advanced Summer Study Institute, McGill University, Montreal. Wallace, P. R. (ed.). New York, Gordon and Breach, Science Publishers, Inc., 1969. 542p. $32.50.

Ten papers are included. Separate abstracts were prepared for each paper. (M.H.R.)

For abstracts of individual papers see: 51540–51549.

51540 SPIN EXCITATIONS IN SUPERCONDUCTORS. Bennemann, K. H. (Univ. of Rochester, N. Y.). pp 3-113 of Superconductivity. Vol. I. Wallace, P. R. (ed.). New York, Gordon and Breach, Science Publishers, Inc., 1969.

The interactions between the conduction electrons and paramagnetic or transition metal impurities are studied. The dynamical aspects of the coupling between the electrons and the magnetic impurities are covered. It is shown that the dynamical coupling between the spin excitation associated with the magnetic impurities and the electrons gives rise to observable effects. Starting with the classical theory by Abrikosov and Gor'kov, the general theory of spin fluctuations in superconductors containing small concentrations of magnetic impurities is developed. In particular, the way spin excitations affect the superconductivity transition temperature, the superconducting order parameter, the energy gap of the single electron excitation spectrum, the upper critical magnetic field, the electronic specific heat, the nuclear relaxation time and, finally, the electronic thermal conductivity is discussed in detail. (M.H.R.)

51541 CRITICAL CURRENTS AND THE ONSET OF RESISTANCE. Ambegaokar, Vinay (Cornell Univ., Ithaca, N. Y.). Contract NONR-401(38). pp 117-58 of Superconductivity. Vol. I. Wallace, P. R. (ed.). New York, Gordon and Breach, Science Publishers, Inc., 1969.

The intrinsic resistive transition in small pieces of superconducting material is discussed. Two recent theoretical approaches are described: a theory of the disappearance of resistance as T approaches T_c (the transition temperature) from above; and a theory of the appearance of resistance in thin filaments as T approaches T_c from below. The problems of how these two distinct theories are to be fitted together are discussed. (M.H.R.)

51542 FLUCTUATIONS OF THE ORDER PARAMETER IN TYPE-II SUPERCONDUCTORS. Maki, Kazumi (Tohoku Univ., Sendai). pp 161-224 of Superconductivity. Vol. I. Wallace, P. R. (ed.). New York, Gordon and Breach, Science Publishers, Inc., 1969.

The time-dependent Ginzburg–Landau equations, which describe the time variation of the order parameter, are used to treat the dynamical fluctuations of the order parameter in Type-II superconductors. The properties of the solutions of this time-dependent equation are explored with due emphasis on the physical meaning. Using linear response theory, the time-dependent Ginzburg–Landau equations are derived. A brief summary of Abrikosov's theory of the Type-II superconductor is included. The classification of the fluctuations in the order parameter in a field H slightly larger than H_{c_2} is covered. The longitudinal mode, in particular, is discussed. The complex conductivity is calculated which turns out to be strongly anisotropic with respect to the direction of the polarization vector relative to the direction of the external magnetic field. The solution of the time-dependent Ginzburg–Landau equation in the presence of a uniform electric field is studied. (M.H.R.)

51543 SYSTEMATICS OF SUPERCONDUCTIVITY. Matthias, Bernd T. (Univ. of California, San Diego, La Jolla. Bell Telephone Labs., Murray Hill, N. J.). pp 227-93 of Superconductivity. Vol. I. Wallace, P. R. (ed.). New York, Gordon and Breach, Science Publishers, Inc., 1969.

An empirical and somewhat metallurgical approach to superconductivity is presented. Errors in superconductivity experiments and in the periodic system are mentioned. A connection between superconductivity and the melting point of a material is made. The superconductivity of uranium is discussed in detail. The effects of pressure, lattice, and electronic structure which determine superconductivity are covered. The possibility of much higher T_c's is discussed. (M.H.R.)

51544 LECTURES ON JOSEPHSON TUNNELLING. Stephen, Michael J. (Massachusetts Inst. of Tech., Cambridge). pp 297-326 of Superconductivity. Vol. I. Wallace, P. R. (ed.). New York, Gordon and Breach, Science Publishers, Inc., 1969.

A formulation of the theory of superconductivity for arbitrary phase of the superconducting wave function is described. The microscopic theory of tunneling is discussed. Certain phenomenological properties of superconducting barriers are discussed. (M.H.R.)

51545 PROPERTIES OF EXCITATIONS IN THE VORTEX STATE OF SUPERCONDUCTORS. Tewordt, Ludwig (Univ., Hamburg). pp 329-69 of Superconductivity. Vol. I. Wallace, P. R. (ed.). New York, Gordon and Breach, Science Publishers, Inc., 1969.

Considering first the excitations at applied fields just above H_{c1}, the bound and continuum states of an isolated vortex line were determined in a clean Type-II superconductor by means of the Bogolyubov equations. Some important properties of the excitations in the mixed state near H_{c2} are derived from the density of states of a lattice of closely spaced vortex lines using the Green's functions satisfying the Gorkov equations. (M.H.R.)

51546 SUPERCONDUCTING ENERGY GAP AND MAGNETISM FIELD EFFECTS. Tinkham, M. (Harvard Univ., Cambridge, Mass.). pp 373-424 of Superconductivity. Vol. I. Wallace, P. R. (ed.). New York, Gordon and Breach, Science Publishers, Inc., 1969.

Some remarks on the energy gap in superconductors are presented, first as modified from simple BCS in strong-coupling superconductors, then as modified in the presence of magnetic

fields. This leads to a review of the use of Ginzburg–Landau theory to treat the effects of strong magnetic fields and also an elementary discussion of the motion of quantized flux in superconductors. (M.H.R.)

51547 PROPERTIES OF SMALL SUPERCONDUCTING SAMPLES IN HIGH MAGNETIC FIELDS. Baratoff, A. (Brown Univ., Providence). pp 427-59 of Superconductivity. Vol. I. Wallace, P. R. (ed.). New York, Gordon and Breach, Science Publishers, Inc., 1969.

Superconductors whose smallest dimension is comparable to or smaller than the size of a Cooper pair are discussed. Various theories involved are mentioned and certain methods of dealing with the equations are proposed. Superheating in bulk low-K superconductors is mentioned. The derivation of Maki's dirty thin film theory generalized to include nonlocal electrodynamics is sketched. Some of the interesting results obtained when this theory breaks down are reviewed briefly. (M.H.R.)

51548 SUPERHEATING AND SUPERCOOLING IN FIRST-KIND SUPERCONDUCTORS. Burger, J. P. pp 463-88 of Superconductivity. Vol. I. Wallace, P. R. (ed.). New York, Gordon and Breach, Science Publishers, Inc., 1969.

Superheating and supercooling effects are presented for all first order transitions: the expected magnetization curve for a bulk Type-I superconductor is presented showing the superheating and supercooling critical field. First, the similarity with other first-order transitions in physics is stressed: the gas-liquid transformation and the hysteresis of ferromagnets. The origin of the surface energy and more quantitative calculation are presented. Experimental results are included for bulk materials, colloidal specimens, and special effects. (M.H.R.)

51549 CALCULATION OF CRITICAL TEMPERATURES USING PHONON DATA. Carbotte, J. P. (McGill Univ., Montreal). pp 491-533 of Superconductivity. Vol. I. Wallace, P. R. (ed.). New York, Gordon and Breach, Science Publishers, Inc., 1969.

First-principle calculations of the critical temperature or, equivalently, the gap in the quasi-particle excitation spectrum for a number of simple metals and alloys is described. The main points in the derivation of the Eliashberg equations are sketched. The discussion of the electron–phonon interaction is based on the diffraction model. How the phonons are completely determined from a Born–von Karman analysis of the dispersion curves measured in the high symmetry direction by means of inelastic neutron scattering is shown. Results of computations using a computer program are presented. (M.H.R.)

51550 SUPERCONDUCTIVITY. VOLUME II. Proceedings of the Advanced Summer Study Institute, McGill University, Montreal. Wallace, P. R. (ed.). New York, Gordon and Breach, Science Publishers, Inc., 1969. 417p. $25.50.

Ten papers on superconductivity are included. Separate abstracts were prepared for each paper. (M.H.R.)

For abstracts of individual papers see: 51551–51560.

51551 HIGH-FIELD SUPERCONDUCTIVITY. Fulde, P. (Univ., Frankfurt am Main). pp 537-64 of Superconductivity. Vol. II. Wallace, P. R. (ed.). New York, Gordon and Breach, Science Publishers, Inc., 1969.

High-field superconductors are characterized by the fact that the critical magnetic field is so high that the effect of the field on the electron spins, as well as on the electron orbits, has to be taken into account. In order to understand the case of a field acting on spin and orbit of the electrons, the two cases were studied separately and the results combined later. The case of zero temperature and no spin-orbital scattering was considered first, but finite values were assumed for both quantities later. (M.H.R.)

51552 PROXIMITY EFFECTS OF THICK SUPERCONDUCTING FILM. Fulde, P. (Univ., Frankfurt am Main). pp 565-76 of Superconductivity. Vol. II. Wallace, P. R. (ed.). New York, Gordon and Breach, Science Publishers, Inc., 1969.

Thermodynamical quantities are calculated such as the jump in the specific heat at T_c for thick superconducting films in metallic contact with paramagnetic films. It turns out that the jump in the specific heat is a much more sensitive measure of the proximity effect than is the reduction in transition temperature. An advantage in these calculations is that the nonlinear Ginzburg–Landau equation can be solved exactly. (M.H.R.)

51553 SUPERCONDUCTIVITY AND THE KONDO EFFECT. Griffin, A. (Univ. of Toronto). pp 579-621 of Superconductivity. Vol. II. Wallace, P. R. (ed.). New York, Gordon and Breach, Science Publishers, Inc., 1969.

Some aspects of the Suhl–Abrikosov–Nagaoka theory for normal metals are reviewed. As a concrete example, the first Kondo corrections to the electronic spin polarization around an impurity and the susceptibility are discussed. The generalization to superconductors is discussed. The determination of T_c is the main concern, which means solving the scattering equations to first order in Δ (the Gor'kov order parameter). (M.H.R.)

51554 EXPERIMENTAL STUDIES OF SUPERCONDUCTORS WITH MAGNETIC IMPURITIES. Parks, R. D. (Univ. of Rochester, N. Y.). pp 625-90 of Superconductivity. Vol. II. Wallace, P. R. (ed.). New York, Gordon and Breach, Science Publishers, Inc., 1969.

The discussion is limited to rare earth impurities known to exhibit well-defined localized moments and the subject of spin-density fluctuations is omitted. Impurity scattering, Anderson's criterion and the Abrikosov–Gor'kov theory are discussed. Under the effects of magnetic ordering the following are covered; anomalous coexistence curves, specific heat studies, the $InLa_{3-x}Gd_x$ system, the Bennemann theory, normal state studies, the Klein–Brout–Marshall theory; further discussion of coexistence curves, and cryptoferromagnetism. Under the effects of applied magnetic fields the following are discussed: different pair breaking regimes, multiple pair breaking regimes, critical field studies of $InLa_{3-x}Gd_x$, and the antiferromagnetic exchange. (M.H.R.)

51555 TIME-DEPENDENT GINSBURG–LANDAU THEORIES. Pike, E. R. (Royal Radar Establishment, Malvern, Eng.). pp 693-717 of Superconductivity. Vol. II. Wallace, P. R. (ed.). New York, Gordon and Breach, Science Publishers, Inc., 1969.

Many attempts to obtain a time-dependent extension of the Ginzburg–Landau theory are surveyed, and it is shown that at present there is no good universal theory. The experimental results for the flux-flow resistivity and other quantities in the clean limit remain unexplained; existing theories predict the wrong dependence on magnetic field. The problems involved are discussed and possibilities for future work are mentioned. (M.H.R.)

51556 TUNNELING AND SUPERCONDUCTIVITY. Rowell, J. M. (Bell Telephone Labs., Inc., Murray Hill, N. J.). pp 721-47 of Superconductivity. Vol. II. Wallace, P. R. (ed.). New York, Gordon and Breach, Science Publishers, Inc., 1969.

The notion of tunneling is discussed, and the way it has been used to measure some properties of superconductors is shown. It is pointed out that certain assumptions about superconductors made in the past are either wrong or misleading. It is intended to make one think in terms of pair and excitations instead of electrons and holes. (M.H.R.)

51557 RELAXATION OF THE COOPER PAIR DENSITY. Schmid, A. (Univ., Karlsruhe, Ger.). pp 751-78 of Superconductivity. Vol. II. Wallace, P. R. (ed.). New York, Gordon and Breach, Science Publishers, Inc., 1969.

A spatially homogeneous and isotropic superconductor (without impurities) is considered where a small deviation of the Cooper pair density from its equilibrium value has been set up initially (say, by heating or electromagnetic fields). This deviation will decay in time e^{-t/τ_R}, where τ_R is the relaxation time of this process and the way to calculate τ_R. A collision of a phonon or an excited electron with a Cooper pair is considered. The normal state is considered for temperatures $T > T_c$, starting from the Gorkov equation and using temperature-dependent Green's function in Nambu's matrix notation. (M.H.R.)

51558 SIZE EFFECTS IN SUPERCONDUCTORS. Guyon, E. (Faculte des Sciences, Orsay, France). pp 781-830 of Superconductivity. Vol. II. Wallace, P. R. (ed.). New York, Gordon and Breach, Science Publishers, Inc., 1969.

The two situations where size effects are important are studied: a superconductor penetrated by a high magnetic field and a superconductor backed by a normal material near the critical temperature of the sandwich $T_c < T_{c_1}$. Topics covered on high magnetic fields are: generalized Ginzburg–Landau equations in superconductors in the dirty limit, subcritical behavior ($H \lesssim H_m$), and tunneling in high fields. The technical aspects, theoretical description, experiments, and magnetic field behavior of proximity effects are discussed. (M.H.R.)

51559 BEHAVIOR OF TYPE-II SUPERCONDUCTORS IN HIGH FIELDS. Saur, E. (Univ., Giessen, Ger.). pp 833-44 of Superconductivity. Vol. II. Wallace, P. R. (ed.). New York, Gordon and Breach, Science Publishers, Inc., 1969.

Measurements carried out on some Type-II superconductors up to very high fields are reported. Some critical data of B–W compounds are presented. The critical field curves for Nb_3Al, Nb_3Sn, V_3Si, V_3Ga, and NbN are given. The quenching curves of V_3Si, and V_3Ga with various conditions of preparation are given. The ex-

perimental values of the upper critical fields at 4.2°K and the extrapolated values of the upper critical fields at zero temperature are listed. The critical field values are a function of the square of reduced temperature. Reduced critical field curves for some B–W compounds and reduced initial slopes of critical field curves versus reduced mean number of collisions are plotted. (M.H.R.)

51560 SUPERCONDUCTIVITY IN THE TRANSITION METALS: PHONONS AND SPIN FLUCTUATIONS. Jensen, M. Anthony (Univ. of Pennsylvania, Philadelphia). pp 847-929 of Superconductivity. Vol. II. Wallace, P. R. (ed.). New York, Gordon and Breach, Science Publishers, Inc., 1969.

The existing experimental and theoretical understanding of the many-body effects in transition metals which are caused by the ion-density fluctuations (phonons) and electron spin-density fluctuations (paramagnons) are described. (auth)

51561 MAGNETIC SURFACE LEVELS IN SUPERCONDUCTORS. Azbel, M. Ya.; Blank, A. Ya. (Inst. of Theoretical Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.), 10: 32-5 (July 5, 1969).

Translated from Zh. Eksp. Teor. Fiz. Pis'ma Redaktsiyu, 10: 49-53(July 5, 1969).

The spectrum of the single-particle excitations in a superconductor is determined in the quasi-classical approximation, and a simple physical interpretation of the quantum states is presented. This analysis starts from Gor'kov's equations for the wave functions of the quasi particles. (M.H.R.)

51562 SUPERCONDUCTIVITY OF ARSENIC AT HIGH PRESSURES. Berman, I. V.; Brandt, N. B. (Moscow State Univ.). JETP Lett. (USSR) (Engl. Transl.), 10: 55-7(July 20, 1969).

Translated from Zh. Eksp. Teor. Fiz. Pis'ma Redaktsiyu, 10: 88-91(July 20, 1969).

The observation of superconductivity of arsenic at pressures 100 to 220 kbar and at temperatures below 1°K is reported. The pressure was determined with a calibration curve drawn through reference points, with accuracy ±20 kbar. The onset of superconductivity was revealed by the changes of the electric resistance. The tests were made on single-crystal As, 99.9999% pure. In the pressure range 100 to 220 kbar, the sample resistance decreased by a factor 7 to 13 when cooled from 240 to 4.2°K. Further lowering of the temperature to below 1°K revealed clearly pronounced transitions into the superconducting state. The plots of the superconducting transitions of As in a zero magnetic field at various pressures are shown. The temperature T_c of the transitions were determined from the midpoints of the curves. (M.H.R.)

51563 HARMONIC GENERATION AND SUBMILLIMETER WAVE MIXING WITH THE JOSEPHSON EFFECT. McDonald, D. G.; Kose, V. E.; Evenson, K. M.; Wells, J. S.; Cupp, J. D. (National Bureau of Standards, Boulder, Colo.). Appl. Phys. Lett., 15: 121-2(Aug. 15, 1969).

By observing constant-voltage steps from Josephson junctions at voltages as high as 17 mV it is deduced that junctions can generate harmonics up to frequencies as high as 8200 GHz. In consonance with this, submillimeter wave laser detection, harmonic generation, and mixing are demonstrated. These results suggest a model for the upper frequency limit of the Josephson effect. (auth)

51564 POSSIBILITY OF ULTRAHIGH CRITICAL FIELDS IN GRANULAR HARD SUPERCONDUCTORS. Watson, J. H. P. (Corning Glass Works, N. Y. Appl. Phys. Lett., 15: 125-7 (Aug. 15, 1969).

It is suggested that refractory superconductors in the form of grains connected by electron tunneling may possess upper critical fields in the megagauss range. (auth)

51565 ADVANCES IN SUPERCONDUCTIVITY. Bardeen, John (University of California, La Jolla). Phys. Today, 22: No. 10, 40-6(Oct. 1969).

Progress in understanding superconductivity is sketched from thermodynamic and phenomenological arguments to the pairing theory. The current interest in problems of space and time variation of the pair potential and in theoretical prediction of relevant parameters is discussed. (M.H.R.)

51566 RESPONSE OF PINNED FLUX VORTICES TO LOW-FREQUENCY FIELDS. Campbell, A. M. (Cambridge Univ., Eng.). J. Phys., C, 2: 1492-1501(Aug. 1969).

The susceptibility of Type-II superconductors in low-frequency alternating current fields was measured using a phase sensitive detector. Penetrations of magnetic field of between 300 Å and 500 μm could be measured and, if it is assumed that a critical state exists, the field profile across the specimen can be plotted on this scale. The response is linear at low amplitude and is consistent with a model based on the reversible oscillation of vortices in harmonic wells. It is not consistent with the signal predicted from "flux creep." The effective potential wells are found to be harmonic up to their edges and only about 25 Å in radius. The resolution is sufficient to show that the surface current is not a critical state, but can be described by a single row of vortices pinned by the boundary of the specimen. (auth) (UK)

51567 EFFECT OF STRONG MAGNETIC FIELD ON SMALL SIZE SUPERCONDUCTORS WITH DIFFUSE REFLECTION AT THE WALLS. Ovchinnikov, Yu. N. (Landau Inst. of Theoretical Physics, Moscow). Zh. Eksp. Teor. Fiz., 57: 894-906(July 1969). (In Russian).

The state density and dependence of ordering parameter Δ on magnetic field strength for eHld ≫ 1 and eHld ≪ 1 (d is the film thickness, l the electron mean free path) are found for thin films. For a sphere with diffuse reflection at the walls the magnetic moment and parameter Δ are determined for an arbitrary field. (auth)

51568 QUANTIZATION OF ELECTRON EXCITATIONS IN S–N–S FILM CONTACTS IN A MAGNETIC FIELD. Galaiko, V. P. (Physical-Technical Inst. of Low Temperatures, Kharkov). Zh. Eksp. Teor. Fiz., 57: 941-8(July 1969). (In Russian).

The problem of spatial quantization of excitations in an extended layer of a normal metal bounded by two superconducting regions is considered on basis of the microscopic equations for the two-component wave function of an "electron–hole" pair excitation. It is shown that when the magnetic field is turned on due to the coherent phase difference of the superconducting ordering parameter, which is proportional to the magnetic flux passing through the normal layer, the quantization becomes unstable and can be replaced by a certain "magnetic" quantization with a distance between the levels which is proportional to the magnetic field strength. (auth)

51569 ON INCREASE OF THE CRITICAL TEMPERATURE OF SUPERCONDUCTORS CONDENSED AT LOW TEMPERATURES. Zavaritskii, N. V. (Inst. of Physical Problems, Novosibirsk, USSR). Zh. Eksp. Teor. Fiz., 57: 752-62(July 1969). (In Russian).

Results of investigation of the tunnel effect in Bi, Ga, Pb, Sn, In, and Al condensed at 2°K are presented. In all metals investigated an increase of the gap width Δ_0 and ratio $2\Delta_0/kT_c$ due to low-temperature condensation was observed. Singularities related to the lattice oscillation spectrum (reproduced for a number of metals) were observed in the tunnel characteristics of all investigated metals for $eV > \Delta_0$. The results are employed to explain the increase of the critical temperature of superconductors condensed at low temperatures. (auth)

51570 ELECTRODYNAMICAL PROPERTIES OF SUPERCONDUCTING CONTACTS. Deutscher, G.; Hurault, J. P.; van Dalen, P. A. (Faculte des Sciences, Orsay, France). J. Phys. Chem. Solids, 30: 509-20(Mar. 1969).

An experimental and theoretical study was made of the linear response to a small dc or ac magnetic field in the normal part of a normal–superconducting N/S binary layer. It was shown that the tunneling characteristic of an N/S sandwich, measured on the N side, is sensitive to the values of the pair potential at points far away from the free surface of the N material. Similar nonlocal effects also appear in the electromagnetic response. The greater the temperature compared to the critical temperature of N, the bigger these effects. Some experimental confirmations of these theoretical predictions were obtained. The theory also explains why a Meissner effect has not been observed in Cu for the Pb/Cu systems, down to 1°K; why, on the other hand, the rf absorption is much smaller in Cu coated with Pb than in normal Cu. (auth) (UK)

51571 INFLUENCE OF A HIGH CURRENT PULSE ON THE ELECTRICAL RESISTANCE IN THE INTERMEDIATE STATE OF SUPERCONDUCTING LEAD FILMS. Huebener, R. P.; Rowe, V. A. (Argonne National Lab., Ill.). Phys. Status Solidi, 35: K21-3(Sept. 1, 1969).

The voltage–current curve of 3-μm-thick Pb films in a transverse magnetic field was measured before and after a 3-A current pulse was applied. The pulse was found to increase the slope (resistance) of the curve by a factor of 11.5, 3.4, 1.4, and 1.08 for fields of 320, 360, 400, and 440 Oe, respectively. A 1- to 2-hr wait or lowering the field to zero and then raising it again restored the curve to its original position. To study the changes in the intermediate state induced by the current pulse, a small oscillatory magnitude field was superimposed on the stationary field. (D.L.C.)

51572 OBSERVATION OF METASTABLE STATES IN TYPE-I SUPERCONDUCTING ALLOYS. Valette, C.; Burger, J. P. (Faculte des Sciences, Orsay, France). J. Phys. (Paris), 30: 562-5(July 1969). (In French).

Experimental studies of the metastable states in InBi alloys (atomic concentration in Bi lower than 1%) were performed from which the value of the Ginzburg–Landau parameter $\varkappa$ was deduced near the critical temperature. These values are consistent with those obtained on more concentrated type-II alloys. (auth)

51573 EFFECT OF VERY SMALL SUPERPARAMAGNETIC GRAINS ON THE TRANSITION TEMPERATURE OF A DIRTY SUPERCONDUCTOR. Dobrosavljevic, Ljiljana (Institut de Physique, Belgrade). J. Phys. (Paris), 30: 589-92(July 1969). (In French).

The transition temperature is estimated for a "dirty" type-II superconductor containing a low concentration of: (a) fine, single-domain ferromagnetic particles; (b) magnetic impurities in solution. The calculation is made only for two limiting cases: (A) $b \gg k_0^{-1}$; (B) $b \ll k_0^{-1}$; where b is the average radius of the ferromagnetic particles, and k_0^{-1} the penetration depth of Cooper pairs into the ferromagnetic regions. In the case (A), T_c becomes independent of the macroscopic magnetization of the ferromagnetic particles. (auth)

51574 SOLUTION OF THE MICROMAGNETIC EQUATIONS OF SUPERCONDUCTORS. Kronmueller, H.; Seeger, A. (Max-Planck-Institut fuer Metallforschung, Stuttgart). Phys. Status Solidi, 34: 781-96(Aug. 1, 1969).

For the solution of the micromagnetic equations of superconductors a method is developed which allows the determination of the elastic stresses from a stress function tensor. It is shown that the elastic strains present in a superconductor have the following sources: spontaneous volume dilatations, dielastic effects, and effects of the nonlinear elasticity theory. The interaction energy of the elastic strains of a superconductor with stress-active lattice defects is determined. The general theory is applied to the discussion of the elastic strains due to a planar S–N wall. (auth)

51575 EFFECT OF HIGH PRESSURE ON THE ENERGY GAP OF INDIUM AND THALLIUM SUPERCONDUCTING FILMS. Galkin, A. A.; Svistunov, V. M.; Dikii, A. P. (Physical-Technical Inst., Donetsk, USSR). Phys. Status Solidi, 35: 421-6 (Sept. 1, 1969).

The effect of high pressure (up to 15,000 atm) on the energy gap of In and Tl superconducting films was investigated by the tunnel effect on superconductor–barrier–superconductor systems. As directly found in the experiments, the In values $2\Delta/kT_c$ indicate a reduction of the electron–phonon interaction under pressure for this metal. In the range up to 8 katm the value $2\Delta/kT_c$ for Tl remained constant within the experimental error and was found to be 3.64 ± 0.06. (auth)

51576 WORKING WITH SUPERCONDUCTION. Harrowell, R. V. New Sci., 43: 655-8(Sept. 25, 1969).

Economic uses of superconductivity in superconducting cables, transformers, dc motors and alternators now under development are described, including a 3000-hp homopolar motor and a supercooled alternator with reciprocating armatures. (auth) (UK)

51577 SUPERCONDUCTIVITY OF ALLOYS OF THE SYSTEM Nb_3Al–Nb_3Ge. Alekseevskii, N. E.; Ageev, N. V.; Mikhailov, N. N.; Shamrai, V. F. (Inst. of Physics Problems, Moscow). JETP Lett. (USSR) (Engl. Transl.), 9: 16-18(Jan. 5, 1969).

Translated from Zh. Eksp. Teor. Fiz. Pis'ma Redaktsiyu, 9: 28-32(Jan. 5, 1969).

It was reported previously that an investigation of the Nb_3Al–Nb_3Ge system revealed a maximum on the plot of T_c against the composition; this maximum was located near the composition $(Nb_3Al)_4$–Nb_3Ge_2, and its magnitude was greatly increased by heat treatment. Additional investigations of the properties of these alloys and of the effect of heat treatment on T_c are reported. (M.H.R.)

51578 INFLUENCE OF AN ALTERNATING MAGNETIC FIELD ON CURRENT FLOWING THROUGH A SUPERCONDUCTOR OF THE SECOND KIND. Sychev, V. V.; Zenkevich, V. B.; Andrianov, V. V.; Baev, V. P. (Inst. of High Temperatures, Moscow). JETP Lett. (USSR) (Engl. Transl.), 9: 31-3(Jan. 5, 1969).

Translated from Zh. Eksp. Teor. Fiz. Pis'ma Redaktsiyu, 9: 53-7(Jan. 5, 1969).

It is known that hysteresis losses arise in a sample of nonideal type-II superconductor placed in an alternating magnetic field. In the absence of an extraneous current flowing in the sample, these energy losses are replaced by the apparatus producing the alternating magnetic field. If direct current from some external source is made to flow through the sample, then the hysteresis losses should change somewhat. The results of the experiment described made it possible to establish an effective resistance to the direct current occurs only if the amplitude of the change in the intensity of the external magnetic field exceeds a certain threshold value $H_\beta > H_{c1}$. (M.H.R.)

51579 MACROSCOPIC WAVE EQUATIONS OF SUPERFLUIDS. Froehlich, H. (Univ. of Liverpool). Phys. Kondens. Mater., 9: 350-8(Sept. 3, 1969).

The wave equation satisfied by the macroscopic wave function which is characteristic for superfluids is presented in a form in which it can be applied to specific problems. It contains a certain amount of interaction between the superfluid and the normal component. (auth)

51580 INFLUENCE OF THE DISSIPATION IN THE SUPERFLUID COMPONENT ON THE FLOW OF LIQUID He II UNDER LOW PRESSURE HEADS. Van Alpen, W. M.; De Bruyn Ouboter, R.; Taconis, K. W. (Kamerlingh Onnes Laboratorium, Leiden). Physica, 44: 51-68(Sept. 8, 1969).

The flow of liquid He II under low-pressure heads is studied. The deviations of the rule of Allen and Reekie are discussed with respect to the dissipation and production of normal excitations in the superfluid. Two pressure differences have to be distinguished, the pressure needed to generate vorticity and the extra pressure associated with the drain of thermal excitations produced by the vorticity. These ideas are compared with the results of an experiment on adiabatic flow in liquid He II. (auth)

51581 OMEGA PHASE FORMATION IN SUPERCONDUCTING Ti ALLOYS. Courtney, T. H.; Wulff, J. (Massachusetts Inst. of Tech., Cambridge). Mater. Sci. Eng., 4: 93-7(May 1969).

The effectiveness of the ω-phase precipitate as a flux pinner in superconducting β-stabilized Ti–V and Ti–Nb alloys was shown to depend on its number density and composition. The variation of critical current density at 50 kG and 4.2°K of drawn and aged 60 wt % Nb–40 wt % Ti alloys as a function of aging time was studied at a variety of aging temperatures. If the diffusivity of Ti is sufficiently greater than that of the Group V element, kinetic analysis indicated that the ω phase becomes enriched in Ti in the early stages of growth without significant particle growth. A decrease in critical current density in a third phase may be regarded as due to dissolution or coarsening. The analysis compares favorably with experimental data obtained for Ti–V and Ti–Nb superconducting alloys. (BBB)

51582 STUDY NEAR T_c OF A TIN RING CONTAINING A WEAK LINK. Lukens, James Edgar San Diego, Calif., Univ. of California, 1968. 115p.

Thesis.

An apparatus was constructed for the measurement of the magnetization of a tin ring containing a weak link near its superconducting transition temperature. Temperature regulation stable to 10^{-5}°K and field measurements with a sensitivity of 0.1 quantum of flux through the ring were achieved. The theory of operation and details of construction of the flux detector used for field measurements are discussed. Over a temperature range, $T_1 < T < T_2$, of about 10^{-3}°K the ring flux jumped spontaneously between low level quantum states. The jumps were directly observed for rates of from 10 to 0.1 jump/sec. The rate varied exponentially with temperature over the range measured. For $T_c > T > T_2$ a persistent current, which was a function of the applied field, flowed in the ring. The amplitude of this current was periodic in applied field with period ϕ_0 (the flux quantum), and its average, I_a, over a change in applied field of ϕ_0 was equal to zero. For $T_2 > T$, $I_a \neq 0$ but depended on the rate of change, V, of the external field. For V = const., $I_a \propto (T' - T)^{\frac{1}{2}}$ where $T' \neq T_c$. For T = const., $I_a \propto$ ln V. Critical current measurements of the weak link with the ring cut so as to be simply connected were made using the flux detector as a very sensitive voltmeter. The critical current, $I_c \propto (\Delta T)^2$. There was a slight decrease of I_c below this dependence very near T_c. This decrease was much less than had previously been reported by others for similar samples. (Diss. Abstr. Int., B)

51583 PROXIMITY EFFECT IN SUPERCONDUCTORS: EXPERIMENTAL AND THEORETICAL DETERMINATION OF THE TRANSITION TEMPERATURE. Jacobs, Allan Edward. Urbana, Ill., Univ. of Illinois, 1968. 207p.

Thesis.

The results of experimental and theoretical investigations of the proximity effect in superconductors are reported, with particular reference to the measurement and prediction of the transition temperature of superimposed films. The theoretical work consists of two parts: (i) an extension of the diffusion approximation theory due to de Gennes, Guyon and Werthamer; this theory is valid only when the mean free paths in the two metals are small compared to the respective coherence lengths, (ii) an extension, under certain restrictive assumptions, of the above theory to all values of the mean free paths. The experimental work consists of measurements of the transition temperature of superimposed films

of indium and thallium deposited at low temperatures. The experimental results are in good overall agreement with the theory, but small deviations are observed. Similar but far-less-extensive measurements have also been made for lead–indium films, for which the strong electron–phonon coupling in lead might invalidate the theory. The experimental results are again in good agreement with the theory, showing that the strong-coupling effects are not large. (Diss. Abstr. Int., B)

51584 NONLINEAR WAVE PROPAGATION ON SUPERCONDUCTING TUNNELING JUNCTIONS. Johnson, Wayne Jon. Madison, Wis., Univ. of Wisconsin, 1969. 202p.

Thesis.

Pulse propagation on a long superconducting tunneling junction that supports Josephson tunneling currents was analyzed. The investigation was restricted to permanent profile pulses that propagate at a constant velocity. A phase plane analysis for the V–I characteristics of a small Josephson junction in a zero magnetic field is presented that explains hysteresis and low voltage (50 to 100 μV) switching which have been experimentally observed. The relationships between the junction parameters and the bias current at the switching points and average V–I characteristics were obtained on an analog computer. A qualitative argument for higher voltage (0.5 to 0.9 mV) switching is given. Also, experimental V–I characteristics of large (1.0 mm^2) area Josephson junction are presented. The propagation of a single flux quantum ($\phi_o = 2.07 \times 10^{-7}$ gauss cm^2) on a long Josephson transmission line including shunt losses (due to tunneling of normal electrons) was established with phase techniques. The detailed relationship between the junction parameters and a distributed bias current were found on an Applied Dynamics 256 analog computer. The results agree with a first-order perturbation analysis in the limit of low bias and velocity. The results of this analysis may also be applicable to the problems of the motion of magnetic domain walls and the motion of slide dislocations in solids. The dynamic steady (d.s.s.) pulse propagation on a long narrow junction including both series and shunt losses was also analyzed. The series loss is due to quasiparticle scattering in the superconductors. The third-order nonlinear differential equation for this problem was programed on the University of Wisconsin's AD256/SDS930 hybrid computer. It was found that a large number of d.s.s. pulse solutions exist for this case. One feature that all of these pulse solutions have in common is that they contain an integral number of flux quanta. The pulse velocity of the first-order solutions (one flux quantum) depends uniquely upon the bias, but the velocity of all higher-order pulses is double valued in the bias. The possibility of the steady propagation of a charging wave was also established. Computer results are presented that relate the bias, the velocity, and the series and shunt losses for the different pulse solutions that may exist on a lead/lead oxide/lead Josephson tunneling transmission line at 2.2, 3.2, 4.2, and 5.2°K. Bias requirements, stability considerations, fabrication, and application problems of these devices are mentioned. (Diss. Abstr. Int., B)

51585 SURFACE SUPERCONDUCTIVITY TO FIELDS MUCH GREATER THAN H_{c3} IN TYPE-I ALLOYS. Joiner, W. C. H. (Univ. of Cincinnati). Phil. Mag., 20: 807-20(Oct. 1969).

Remnant superconductivity is observed in type-I Pb–Tl foils to fields in excess of seven times the bulk critical field. These enhanced critical fields are obtained by working the foil surfaces. The degree of critical field enhancement depends on the topology of the surface, as well as on the presence of lattice defects. Explanations for anomalous nucleation fields based principally on size effects are inadequate to explain the present data. Enhancements expected from the increase in the Ginzburg–Landau parameter resulting from dislocation scattering of electrons are also much smaller than those observed. A field enhancement resulting from the presence of two planar defects as described by Tilley (1968) is consistent with the data, although there is no evidence that such a structure in fact exists. (auth) (UK)

51586 DETECTION OF SINGLE QUANTIZED VORTEX LINES IN ROTATING He II. Packard, Richard E.; Sanders, T. M. Jr. (Univ. of Michigan, Ann Arbor). Phys. Rev. Lett., 22: 823-6(Apr. 21, 1969).

The trapping of electrons on quantized vortex lines in rotating He II was utilized to permit detection of single lines in order to study the appearance and disappearance of the first few lines in a capillary rotating about its axis. It seems likely that an extension of the method will permit study of the spatial distribution of vortices in rotating vessels of He II. (auth)

Plasma and Thermonuclear Physics

Refer also to abstract 51857.

51587 (JPRS–46949) RESEARCH IN TECHNICAL PHYSICS. Translated from Zh. Tekh. Fiz., 38: 1405-19; 1442-8; 1465-71; 1475-6; 1482-9; 1521-8; 1529-33; 1581-7(1968). 81p. CFSTI.

Separate abstracts were prepared for 5 of the included papers. The other papers were not in scope for NSA or were included directly from the journal. (M.O.W.)

For abstracts of individual papers see: 51604, 51650, 51705, 51720, and 52045.

51588 (NP–17634) FIFTEENTH SIX-MONTHLY PROGRESS REPORT, 1ST JANUARY–30TH JUNE 1968. (Sydney Univ. (Australia). School of Physics). 9p. (PR–15). Dep.

Progress is briefly reported on: plasma sources (SUPPER-I, -II, and -III), large-amplitude Alfvén waves, microwave and laser diagnostics, and decay of plasma in SUPPER-I. Ten preprints during the period, eight of which appeared in journals, are listed. (M.O.W.)

51589 (SU-IPR–333(Rev.)) BIBLIOGRAPHY OF STANFORD INSTITUTE FOR PLASMA RESEARCH REPORTS, PAPERS, AND CONFERENCE PRESENTATIONS. (Stanford Univ., Calif. Inst. for Plasma Research). Revised July 1969. 49p.

333 items published by this institute are listed. An author index is included. (M.O.W.)

Confinement and Heating

Refer also to abstract 51632.

51590 PLASMA CONTAINMENT IN THE PRINCETON SPHERATOR USING A SUPPORTED SUPERCONDUCTING RING. Freeman, R.; Okabayashi, M.; Pacher, H.; Pacher, G.; Yoshikawa, S. (Princeton Univ., N. J.). Phys. Rev. Lett., 23: 756-60(Oct. 6, 1969).

Investigation of plasma confinement in the Princeton spherator by use of a supported superconducting ring shows that about 90% of the total particles are lost to the supports, and thus the particle loss across the magnetic field is reduced to about 10% of the total loss under the best operating conditions. An hypothesis, in terms of convective cells established by the presence of supports, is proposed to explain the observed plasma loss. (auth)

51591 PLASMA DIFFUSION IN STELLARATORS. Kadomtsev, B. B.; Pogutse, O. P. JETP Lett. (USSR) (Engl. Transl.), 10: 64-7(July 20, 1969).

Translated from Zh. Eksp. Teor. Fiz. Pis'ma Redaktsiyu, 10: 101-5(July 20, 1969).

A straight system is considered with cylindrical magnetic surfaces and with a field $B_z = B[1 + \epsilon \cos(lv - k_0 z)]$, where ϵ is the depth of modulation of the magnetic field by the helical winding, l is the multiplicity of the helical winding, and k_0 is the reciprocal of its period on the z axis. Small plasma oscillations strongly elongated along the magnetic field are considered, so that the corresponding longitudinal wave number is $k_z \ll k_0$. (M.O.W.)

51592 ION HEATING IN THE TOKAMAK-3 SETUP. Artsimovich, L. A.; Anashin, A. M.; Gorbunov, E. P.; Ivanov, D. P.; Petrov, M. P.; Strelkov, V. S. JETP Lett. (USSR) (Engl. Transl.), 10: 82-7(Aug. 5, 1969).

Translated from Zh. Eksp. Teor. Fiz. Pis'ma Redaktsiyu, 10: 130-3(Aug. 5, 1969).

Measurements were made at a longitudinal magnetic field intensity 25 to 38 kOe, a longitudinal current 60 to 12 kA, and a process duration 30 to 70 msec. The plasma density was 3 to 6×10^{13} cm^{-3} and the temperature of the electronic component was ~1 keV. Ion energy distribution curves are given. (M.O.W.)

51593 ON THE HEATING MECHANISM OF A PLASMA DURING DEVELOPMENT OF BEAM INSTABILITY OF A STRAIGHT DISCHARGE CURRENT. Karchevskii, A. I.; Bezmel'nitsyn, V. N.; Makeev, G. N.; Muromkin, Yu. A. Zh. Eksp. Teor. Fiz., 57: 815-26(July 1969). (In Russian).

It is shown that during development of beam instability of a current in a straight discharge with a current strength up to 400 A, beams of accelerated electrons arise with energies of several keV. The beam current is comparable to the total discharge current and reaches hundreds of amperes. The electron density in the beam is 2×10^9 cm^{-3}, which is about 10^{-3} of the electron density in the plasma. The electric potential drop in the plasma at the moment of instability development is concentrated in a region about 20-cm long, which in various discharges is located at various points along the plasma column. By bolometric measurements it is found that up to 50% of the energy stored in the external circuit is transferred to the accelerated electron beam; from 1 to 3% of the external circuit energy is transmitted to hot electrons confined by the mirror machine. It is demonstrated that heating of plasma electrons in a mirror machine during the extinction of a straight discharge cur-

rent, as observed earlier, is due to interaction between the accelerated electron beam and the plasma. (auth)

51594 INJECTION AND CONTAINMENT OF CHARGED PARTICLES IN A CUSP MAGNETIC FIELD. Strijland, W. (FOM-Instituut voor Plasma-Fysica, Jutphaas, Netherlands). Physica, 44: 241-59(Sept. 15, 1969).

Injection and containment of charged particles in a cusp magnetic field are studied by means of an electron experiment and orbit calculations. In the central part the particle motion is highly nonadiabatic, whereas in the outer regions a quasi-magnetic moment can be introduced. The density distribution is calculated and compared with statistics on the computer orbits. The decay is calculated by considering the central part of the field as a randomizing region. As a substitute for the usual mirror ratio a field parameter r/r_0 is introduced. The edge of the central region is denoted by r_0, which is a function of the particle energy and the gradient of the magnetic field; r is the edge of the magnetic bottle. For low values of the mirror parameter, theory, experiment, and statistics agree. For higher values long-contained orbits cause a deviation. For $r/r_0 = 12$ this results in a threefold higher density; the average number of transits is 40. Combination of a conical injection gun and magnetic compression of the beam produces appreciable capture of the particles, nearly always more than 40%. Some results of an ion injection experiment are mentioned for comparison. (auth)

51595 EFFECT OF MAGNETIC SHEAR ON CONFINEMENT OF A QUIESCENT ASYMMETRIC PLASMA. Mosher, David. Princeton, N. J., Princeton Univ., 1968. 83p.

Thesis.

Early experiments on the L-2Q device demonstrated that the application of magnetic shear could dramatically reduce the cross-field plasma loss. More recent work revealed that the radial flux of plasma which could be attributed to the turbulent low-frequency fluctuations was insufficient to account for the observed losses. In this work, it is shown that: (1) very small azimuthal temperature gradients on the end-plates of the L-2Q can produce relatively large asymmetries in plasma potential; (2) the resulting dc azimuthal electric fields can drive the ions out of the plasma at a rate sufficient to account for observed losses; and (3) the presence of shear can dramatically reduce the dc convective losses. (Diss. Abstr.)

51596 HYDROGEN PLASMAS HEATED BY ION CYCLOTRON RESONANCE. Snyder, John William. Columbus, Ohio, Ohio State Univ., 1968. 69p.

Thesis.

A new type of two-phase exciter coil system was designed and constructed which heats and confines a hydrogen plasma at the ion cyclotron frequency in a magnetic bottle. The exciter coil system produced a rotating electric field and a revolving magnetic field. The maximum value of the rotating electric field was 3.5 V/cm on the axis of the magnetic bottle while the maximum value of the revolving magnetic field was 16 G at the inside surface of the 4-inch I.D. vacuum bottle. A two-phase frequency of 3.96 MHz operated the exciter coils, which frequency produced ion cyclotron resonance when the center of the magnetic bottle (mirror ratio of 2.38) was 2500 G. An axial ion temperature of 17,000°K at resonance was determined by measuring with a Fabry–Perot interferometer the Doppler broadening of the H_α line ($\lambda = 6563$ A) emitted by the plasma. Evidence that ion cyclotron resonance was achieved was obtained from light output measurements on the plasma as well as from the Doppler-broadening measurements. A method of achieving charge neutralization was devised in which two sets of exciter coils with four coils in each set were operated 180° out of phase. The two sets of exciter coils were placed along the magnetic bottle field lines with 11 inches between exciter coil centers. An arrangement of this type allowed electrons in the plasma to flow along the lines of magnetic induction and neutralize the ions which are accelerated in a group. The rotating electric field system described here was outlined for extension to multiple bottle systems with intersecting ion orbits. The method lends itself to the production of head-on collisions between deuterons and tritons, as well as between deuterons and deuterons. (Diss. Abstr.)

51597 MOTION OF CHARGED PARTICLES IN A MAGNETIC TRAP WITH A MIRROR CONFIGURATION. Dubinina, A. N.; Krasitskaya, L. S.; Yudin, Yu. N. (Inst. of Nuclear Physics, Novosibirsk, USSR). Plasma Phys., 11: 551-64(July 1969).

The motion of individual charged particles in axially-symmetric and axially-asymmetric magnetic traps having a mirror configuration is discussed and the boundary between the stable and unstable regions of motion is found. It is shown that the two kinds of trap do not in principle belong to different systems. A discussion based on the experimental results is given for the possibility that the particles might remain in the space between the mirrors for an infinitely long time. (auth) (UK)

Diagnostics

Refer also to abstracts 51704, 51722, and 51732.

51598 (CEA-CONF-1373) PLASMA FOCUS STRUCTURE FROM ONE NANOSECOND SCHLIEREN AND SHADOW PICTURES. Baconnet, J. P.; Cesari, G.; Coudeville, A.; Watteau, J. P. (Commissariat a l'Energie Atomique, Villeneuve-Saint-Georges (France)). [1969]. 4p. (CONF-690803-16). Dep. CFSTI (U. S. Sales Only).

From 9th International Conference on Phenomena in Ionized Gases, Bucharest, Romania.

Schlieren techniques have been used to study the structure of the plasma sheet produced by a coaxial plasma gun working in a focus regime. Preceding axial schlieren pictures are completed here by transverse ones and by shadowgrams to improve the spatial resolution; attempts are made to link the sheet aspect with the neutron yield. (auth)

51599 (CEA-CONF-1374) IONIC TEMPERATURE MEASUREMENTS BY 90° COOPERATIVE SCATTERING ON A PLASMA FOCUS. Baconnet, J. P.; Cesari, G.; Coudeville, A.; Watteau, J. P. (Commissariat a l'Energie Atomique, Villeneuve-Saint-Georges (France)). [1969]. 4p. (CONF-690803-17). Dep. CFSTI (U. S. Sales Only).

From 9th International Conference on Phenomena in Ionized Gases, Bucharest, Romania.

It is known that the plasma sheath reaches the axis when the current derivative is minimum. The present measurements are done 10 ns before that time when the ions heated by the shock wave have a temperature much higher than the electrons. $\alpha = K\sqrt{n_e/T_e}$ is then large enough, and the diffusion is mainly due to the ionic component. Later in time the electrons are heated by the ions, the α value decreases, and the diffusion becomes only "electronic." The spectrum is spread over a wavelength range multiplied by $(m_i/m_e)^{1/2}$ and the signal-over-noise ratio becomes smaller than unity. (auth)

51600 (CEA-CONF-1375) DENSITY PROFILE DETERMINATION IN A LASER CREATED PLASMA BY AN HOLOGRAPHIC METHOD. Bobin, J. L.; Buges, J. C.; Rouzaud, P.; Terneaud, A. (Commissariat a l'Energie Atomique, Villeneuve-Saint-Georges (France)). [1969]. 4p. (CONF-690803-19). Dep. CFSTI (U. S. Sales Only).

From 9th International Conference on Phenomena in Ionized Gases, Bucharest, Romania.

The experimental apparatus is described. A typical interferogram is given. Density profiles were determined from the interferogram and comparisons were made with previous data. (M.O.W.)

51601 (CEA-CONF-1392) DENSITY MEASUREMENTS BY NONLINEAR INTERACTION OF ELECTROMAGNETIC WAVES IN A MAGNETIZED PLASMA. Cano, R.; Etievant, C.; Fidone, I.; Zanfagna, B. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). [1969]. 4p. (CONF-690803-20). Dep. CFSTI (U. S. Sales Only).

From 9th International Conference on Phenomena in Ionized Gases, Bucharest, Romania.

The results obtained on a low-density argon plasma in a constant magnetic field are presented. The values of the density obtained by this method are compared with those given by the well-known methods of linear propagation of waves. (M.O.W.)

51602 (CEA-CONF-1393) DENSITY PROFILE MEASUREMENT WITH THE PROPAGATION OF AN EXTRAORDINARY WAVE. Tulle, P. A. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). [1969]. 4p. (CONF-690803-29). Dep. CFSTI (U. S. Sales Only).

From 9th International Conference on Phenomena in Ionized Gases, Bucharest, Romania.

These diagnostic methods require much shorter wavelengths than the cutoff of the ordinary mode. In comparison with ordinary interferometry, they give the radial repartition of density. By working with the second cutoff ($a^2 = 1 + b_*$), one can extend the domain of utilization of the hyperfrequencies as regards the plasma density. It is very important to note that one always has $\omega \sim \omega_c$, i.e., the frequency is determined by the magnetic field strength. (auth)

51603 (CEA-CONF-1394) DETERMINATION OF PLASMA POTENTIAL USING AN EMISSIVE PROBE IN A MAGNETIC FIELD. Deschamps, P. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). [1969]. 4p. (CONF-690803-21). Dep. CFSTI (U. S. Sales Only).

From 9th International Conference on Phenomena in Ionized Gases, Bucharest, Romania.

The hypothesis that compares an emissive probe in a plasma to a diode with electrode spacing equal the Debye length of the plasma seems justified for a plasma where $T_e \gg T_s$, $T_e \gg T_i$, and $J_{eo} \gg J_i$. A special geometry of the probe and a detailed analysis of the emitted current allows one to directly determine the plasma potential in the presence of a magnetic field. The obtained values are practically the same as the values of probe potential where the "cold" probe characteristic exhibits an inflection point. This method applied to a quiescent plasma generated by an hf source shows that the static radial electric field within the density gradient is less than 1 V/cm. (auth)

51604 (JPRS-46949, pp 1-22) HOLOGRAPHIC PLASMA DIAGNOSTICS: A SURVEY. Zaidel, A. N.; Ostrovskaya, G. V.; Ostrovskii, Yu. I. Translated from Zh. Tekh. Fiz., 38: 1405-19(1968).

This is a review article devoted to the application of holographic methods in the investigation of plasma, and reports work performed in 1966 and 1967. Various possibilities of these methods and prospects of their development are discussed. An interesting feature of the holographic method is that it can be used to illuminate the plasma simultaneously at different angles in a wide range (almost 80 to 90°). This makes holography suitable for a determination of the spatial distribution of the plasma parameters. Another advantage of holography is that it is insensitive to the radiation produced by the plasma itself. The article deals separately with both the phase and amplitude distortions occurring when the holography beam passes through the plasma, and methods of extracting information concerning the state of the plasma on this basis. The requirements that must be satisfied by the lasers and the photographic materials when used for this purpose are discussed, and holography methods with time resolution are described. Other uses of holography techniques are for the investigation of the plasma of a laser spark, the investigation of a plasma theta pinch, the investigation of a plasma in powerful flash lamps, and the investigation of stationary plasma. Most of the procedures described are those developed in the authors' laboratory. (ATD)

51605 (NP-tr-1840) THOMSON SCATTERING OF RUBY LASER LIGHT BEHIND A COLLISIONLESS SHOCKWAVE FRONT. Babenko, A. N.; Kruglyakov, E. P.; Kurtmullaev, R. Kh., Papyrin, A. N. ([Akademiya Nauk SSSR, Novosibirsk. Institut Yadernoi Fiziki]). Translated for Culham Lab., Abingdon, Eng., from Preprint No. 286. 8p. (CTO-629). Dep. CFSTI (U. S. Sales Only).

The electron temperature T_e behind a collisionless shockwave front is measured by the Thomson scattering of the light from a ruby laser. The results are compared to the T_e values measured with a diamagnetic probe and the results obtained by numerical computation. The experimentally measured T_e obtained by both methods agree within 20%. For $H > H_{crit}$ the measured electron temperature is several times smaller than the value computed on the assumption that the wave energy is only dissipated by the Joule heating of the electrons, while in actual experimental conditions considerable ion heating is expected to take place. (auth)

51606 SPECTROSCOPIC INVESTIGATIONS OF STRONG H-CONSTRICTED DISCHARGE PLASMA. Gorshkova, L. D.; Gorshkov, V. A.; Podmoshenskii, I. V. Teplofiz. Vys. Temp., 7: 1-5(Jan.-Feb. 1969). (In Russian).

Quantitative spectroscopic investigations were conducted on a H-constricted discharge plasma in a trough at a current of 5400 A, a magnetic intensity of 1.2×10^6 A/m, and a trough width of 1 cm. It was found that the plasma is stationary during the π-shaped section of the current pulse. The temperature fields in the plasma and the distribution of pressure and current densities were along the direction of action of the ponderomotive force. (tr-auth)

51607 SPECTROSCOPIC MEASUREMENTS OF WEAKLY IONIZED ARGON PLASMA JET. II. SPECTROSCOPIC MEASUREMENTS OF WEAKLY IONIZED ARGON PLASMA FLOW PREMIXED WITH N_2 IN PLENUM CHAMBER. Kamimoto, Goro; Shirai, Hiroyuki. Nippon Koku Gakkaishi, 17: 150-9(1969). (In Japanese).

The properties of a weakly ionized Ar plasma premixed with N_2 in the plenum chamber were studied by a spectroscopic technique. A preliminary study was made of the physical processes occurring in the plenum chamber, and it was shown that three competitive reactions (of the ground state nitrogen molecule, free electron, and ground state Ar atom for the metastable Ar atom) play an important role in the possible reactions that may take place. The rotational temperatures using the N_2 second positive (0,0) band were also measured taking account of the overlapping of P and R branches. It was found that the electron temperature was about twice as large as the rotational temperature. Such measurements of the free stream in the test section were difficult because of the lack of knowledge of the excitation mechanism from $X^1\Sigma$ state of N_2 to $C^3\Pi$ by the metastable Ar atom. (BBB)

51608 MEASUREMENT OF MAGNETIC FIELDS IN PLASMAS BY THE FARADAY EFFECT USING RESONANT LASER RADIATION. Wheeler, C. B.; Troughton, J. (Imperial Coll. of Science and Tech., London). Plasma Phys., 11: 541-9(June 1969).

Measurement of Faraday rotation has for many years been used as a technique for evaluating the product of magnetic field H and electron density N_e in a plasma. This paper determines the equivalent rotation for the case when the probing radiation is within the emission profile of one of the plasma lines. The probing radiation considered is that of a gas laser and the resonant technique requires that the plasma under investigation contains some of the active lasing element; this may be introduced as a trace impurity in a plasma that would otherwise be unsuitable. The theory of the technique is valid over the range of plasma N_e and T for which L.T.E. holds and also for which Stark microfiled broadening greatly exceeds the thermal Doppler broadening of the resonant transition. The main limitation on H is that the electron gyration radius in the plasma should greatly exceed the Debye length. Complete numerical calculations are given for a plasma containing argon used in conjunction with an argon ion laser as radiation source and there is excellent agreement with measurements made on a linear pinched discharge in argon. (auth) (UK)

51609 DIAGNOSTICS OF DENSE PLASMA WITH THE RESONANT SCATTERING OF GAMMA RAYS. Isaev, I. F.; Kudrin, L. P. (Inst. of Atomic Energy, Moscow). Teplofiz. Vys. Temp., 6: 769-72(Sept.-Oct. 1968). (In Russian).

The method of measurement of temperature in optically dense partially ionized plasma with nuclear-resonant gamma fluorescence is proposed. The measurement of the temperature distribution, carried out together with the measurement of density and pressures, serves to study the equation of state of nonideal plasma. (tr-auth)

51610 APPLICATION OF UHF BRIDGE CIRCUITS FOR INVESTIGATION OF PROPERTIES OF PLASMA IN SHOCK TUBES. Krylov, V. V.; Popyrin, O. I.; Tusnov, Yu. I. (Moscow State Univ.). Teplofiz. Vys. Temp., 6: 905-11(Sept.-Oct. 1968). (In Russian).

Results are given for transverse and longitudinal uhf-microwave scattering on argon plasma in shock fronts. (tr-auth)

51611 INVESTIGATIONS OF ELECTRIC CONDUCTIVITY IN FLOW OF AIR PLASMA WITH COLD ELECTRODES IN TRANSVERSE MAGNETIC FIELD. Gorelova, M. A.; Gorelov, V. A. Teplofiz. Vys. Temp., 6: 912-16(Sept.-Oct. 1968). (In Russian).

Electric conductivity was measured with a system of electrodes placed in the stream of air plasma in strong shock waves in a magnetic field (B = 160 to 1500 gauss). Current flow between electrodes in near-electrode layers is discussed. The potential distribution between the electrodes was measured. Experimental values of electric conductivity agree with calculated values. (tr-auth)

51612 HIGH-RESOLUTION LASER INTERFEROMETER FOR MEASUREMENT OF ELECTRON DENSITY IN TRANSIENT PLASMA. Kano, T.; Heaton, A. G. (Univ. of Manchester, Eng.). Electron. Lett., 5: 413-15(Aug. 21, 1969).

A laser interferometer of the Mach–Zehnder type based on the use of a single-mode frequency-stabilized He–Ne gas laser, 6329 Å in wavelength and with 100 μV output, was used to measure accurately electron densities in the range 10^{14}–10^{15} cm^{-3} in a transient mercury-vapor plasma. An "amplitude" (intensity) modulation system was employed in order to obtain a wide dynamic range. The interferometer system is mounted on a massive movable table in order to obtain the spatial distribution of electron density by means of sequential discharges. The experimental results show clearly that there are definite time delays between the peak of current in the discharge and the maximum value of the (average) electron density. The results are in good agreement with the values of electron densities obtained by the extrapolation from microwave measurements. (auth) (UK)

51613 CONFIRMATION OF ABNORMALLY HIGH ELECTRON DENSITY IN A TRANSIENT MERCURY-VAPOUR PLASMA BY LASER-INTERFEROMETER MEASUREMENTS. Heaton, A. G.; Kano, T.; Pal, D. K. (Univ. of Manchester, Eng.). Electron. Lett., 5: 295-6(June 26, 1969).

An optical interferometer employing a low-power (100 μW) beam from a frequency stabilized He–Ne laser was used to find the effective change in path length due to the transient plasma in terms of fractional fringe shift. The results confirm the magnitude of electron density previously deduced from the extrapolated microwave results and indicate a distinct time lag in the buildup of

maximum electron density with respect to the transient current maximum. This implies a fall in drift velocity of electrons from the current peak to the electron-density peak, which is a function of the degree of ionization achieved. (auth) (UK)

51614 MEASUREMENT OF MAGNETIC FIELDS IN PLASMAS BY THE VOIGT EFFECT USING RESONANT LASER RADIATION. Wheeler, C. B.; Troughton, J. (Imperial Coll. of Science and Tech., London). Plasma Phys., 11: 601-9(July 1969).

This paper proposes a method of measuring the ratio of the magnetic field H in a plasma to the free electron density N_e utilizing the magnetic double refraction exhibited by a plasma in the neighborhood of an absorption line as a consequence of the transverse Zeeman effect. It is shown that the phase difference introduced by the plasma between the two refracted polarized beams can be as large as tenths of a radian. The probing radiation considered is that of a gas laser and the resonant technique requires that the plasma under investigation contains some of the active lasing element; this may be introduced as a trace impurity in a plasma that would otherwise be unsuitable. Numerical calculations are given for a plasma containing argon used in conjunction with an argon ion laser as radiation source and there is good agreement with measurements made on a linear pinched discharge in argon provided some assumptions are made concerning the inhomogeneity of the plasma used. (auth) (UK)

51615 CALCULATION OF THE ELECTRON DISTRIBUTION FUNCTION OF A LORENTZIAN PLASMA SUBJECT TO A FREQUENCY MODULATED ELECTRIC FIELD. Allouche, Daniel; Jancel, Raymond; Kahan, Theo (Institut Henri Poincare, Paris). Compt. Rend., Ser. B, 269: 9-11(July 7, 1969). (In French).

A method of approximation more adequate than that of previous works of the authors is proposed for the system of differential equations verified by the Fourier components for the electron distribution function of a Lorentzian homogeneous and isotropic plasma subject to a uniform electric field. (J.F.P.)

51616 NEW PLASMA DIAGNOSTIC TECHNIQUE: THE SONIC PROBE. Saxena, A. P.; Gaur, S. C.; Raipur, M. P. Plasma Phys., 11: 611-13(July 1969).

A method of determining the degree of ionization of a plasma is described in which acoustic waves (1 to 40 kc) are transmitted through the plasma and detected, and the velocity of propagation calculated. (UK)

51617 PLASMA INVESTIGATION IN TUMAN MACHINE BY PROBING WITH FAST ATOMIC BEAMS. Afrosimov, V. V.; Gladkovskii, I. P.; Kislyakov, A. I. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekh. Fiz., 38: 1888-96(Nov. 1968). (In Russian).

Hydrogen and argon atom beams of several keV were used for probing plasma in the toroidal device, Tuman, designed for studying adiabatic compression of plasma by magnetic fields. The attenuation of the hydrogen atomic beam was used for determining the mean cross section of plasma concentration. The attenuation of argon atom beam was used for estimating the electron temperature of plasma under ohmic heating and T_e variation during compression. Plasma concentration as a function of time and external discharge parameters under ohmic heating was determined. It was found that plasma concentration during compression increased 5.5 to 6 times, while electron temperature increased only slightly. (tr-auth)

51618 PROBE DIAGNOSTICS OF A PLASMA AT MEDIUM PRESSURES. Golubovskii, Yu. B.; Kagan, Yu. M.; Mikhel, P.; Nesterova, L. L. (Leningrad State Univ.). Zh. Tekh. Fiz., 38: 1996-8(Nov. 1968). (In Russian).

In previous publications on probe diagnostics in plasma the concentration of ions was determined, considering the ion current on the probe at large negative probe potentials. However, they did not take into account the possibility of electrons being knocked out from the probe by ions, metastable atoms, and quantum resonance emission. Although the first two effects do not play a significant role, the part of photo effect needs to be better known. Experimental studies were made of the influence of the photoeffect in diagnostics of plasma at medium pressures. The measurements were carried out in neon, argon, and helium at pressure of 10 torr and discharge currents 25, 50, and 100 mA. (R.V.J.)

51619 SPECTROSCOPIC INVESTIGATION OF HELIUM PLASMA FORMED IN A THETA PINCH. Razmadze, N. A.; Sholin, G. V.; Pavlovskii, A. K. Zh. Prikl. Spektrosk., 9: 43-9 (July 1968). (In Russian).

Measurements were made using a spectrograph and photomultiplier of the intensities of the He lines 4471 and 4686 Å in the dense theta-pinch helium plasma. For the 4686 Å line, in addition to determination of the general intensity, measurements of the profile resulting from Stark broadening were accomplished. According to the results, a general picture of development of the process of excitation, ionization, and recombination in the plasma was attained. Values of electron temperature and density in relation to the phase of discharge were determined. Possibilities are discussed of obtaining inversion of the populations of optical levels of the theta-pinch ions in the compression phase, which is accompanied by a quick increase of electron temperature and density, and in the expansion phase, which is characterized by such a decrease of these parameters, upon which ionic occupancy levels are realized, chiefly by way of the impact-radiation recombination. (tr-auth)

51620 INVESTIGATION OF THE ION SPECTRUM OF A PLASMA HEATED BY A SHOCK WAVE. Alinovskii, N. I.; Eselevich, V. G.; Koshilev, N. A.; Kurtmullaev, R. Kh. (Inst. of Nuclear Physics, Novosibirsk, USSR). Zh. Eksp. Teor. Fiz., 57: 705-15(July 1969). (In Russian).

The energy spectra of ions in a plasma heated by a shock wave are investigated by the passive corpuscular diagnostics technique. For large Mach numbers ($M \gtrsim 3$ to 4) single-velocity motion of ions in a plasma current is violated up to the moment of wave cumulation at the system axis. This can be explained by "overturning" of the shock wave front under these conditions. The experimental relative width of the energy spectrum of particles emitted in the longitudinal and transverse directions indicates a strong collisionless dissipation of energy under all conditions investigated. (auth)

Kinetics (General)

51621 CONTRIBUTION TO THE STATISTICAL THEORY OF A DENSE PLASMA. Vorob'ev, V. S.; Norman, G. E.; Filinov, V. S. (Inst. of High Temperatures, Moscow). Zh. Eksp. Teor. Fiz., 57: 838-49(July 1969). (In Russian).

A strongly imperfect nondegenerate plasma is considered. The partition function is reduced to the form of a classical configurational integral in which the interaction energy for each particle pair is expressed by a pseudopotential determined from the quantum mechanical analysis of a two-particle system. Quantum effects in a dense plasma can be taken into account in this way and the Monte Carlo method developed in the theory of strongly imperfect classical fluids can be employed for calculating thermodynamic quantities. Electrons and ions are not divided into free and bound ones in the calculations. The form of the pseudopotentials is discussed. Calculations for a hydrogen plasma at 10,000 and 30,000°K are performed. The results for a plasma close to an ideal plasma are in accordance with the data of other calculations. The degree of ionization and equation of state of a dense plasma are found. The limits of applicability of the method for investigating a dense plasma due to extreme atom and electron concentrations, to the effect of microfields and to the possibility of molecule formation are discussed. (auth)

51622 MEASUREMENT OF EMISSION AND ABSORPTION COEFFICIENTS OF THE BALMER LINE $H\alpha$. Griffith, Russell; Bober, Lawrence; Tankin, Richard S. (Northwestern Univ., Evanston, Ill.). Plasma Phys., 11: 529-39(June 1969).

The Balmer line $H\alpha$ was studied spectroscopically using a hydrogen plasma generated in a high-current, low-voltage, free-burning arc. Absorption coefficients and emission coefficients corrected for self-absorption were measured over a temperature range of 10,000°K to 20,000°K at 1 atm pressure. Transition probability and line profiles were in good agreement with theory. The ratio of emission coefficient to absorption coefficient agreed with the Planck function, indicating the existence of local thermodynamic equilibrium. (auth) (UK)

Kinetics (Experimental)

51623 (CLM-R-99) COLLISIONLESS INTERACTIONS IN INTERSTREAMING PLASMA JETS. Little, P. F.; Avis, B. E.; Turner, R. B. (United Kingdom Atomic Energy Authority, Abingdon (England). Culham Lab.). Apr. 1969. 25p. Dep. CFSTI (U. S. Sales Only). UK 3s. 3d.

The potential fluctuations detected by an external probe when two collision-free plasma jets stream through each other in a magnetic field are described. The noise spectrum is enhanced in a frequency range where ions of one plasma are expected to generate noise by their interaction with the common electron cloud. This is the first experimental evidence for the existence of the ion–electron instability in interstreaming plasmas. The noise spectrum of a single plasma jet shows evidence of an instability driven by the perpendicular velocity of the ions which has been observed previously. (auth) (UK)

51624 (JUL-578-PP) BREMSSTRAHLUNG OF COMPLETELY IONIZED PLASMA IN THE INFRARED. Rusbueldt, Dankwart (Kernforschungsanlage, Juelich (West Germany). Institut fuer Plasmaphysik). Mar. 1969. 66p. (In German). Dep. CFSTI (U. S. Sales Only).

Measurements of the continuum radiation of a plasma with high temperature ($T_e \approx 10^6$°K) and density ($n_e \approx 3 \times 10^{17}$ cm^{-3}) in the spectral range from $\lambda = 0.27$ up to 22 μ are reported. The plasma was produced in a theta-pinch apparatus with deuterium or helium as the filling gas. Observations were perpendicular to the coil axis of the theta pinch. In the region investigated $h\omega \ll kT$ is valid, and the emitted continuum is pure bremsstrahlung. The emission coefficient depends on the frequency ω approximately logarithmically over the Gaunt factor. The Gaunt factor is derived classically and from quantum mechanics. The effect of adjacent particles is considered by a Debye potential for the slowing-down ion. A corrector is obtained by application of the Born approximation. The frequency dependence of the Gaunt factor over as broad a spectral range as possible was calculated. There was agreement with theory within the limits of measurement error of less than 10%. This suggests the application of the bremsstrahlung continuum as radiation normal, especially in the ultraviolet. For measurements in the infrared, fast semiconductor detectors were used, and their properties were first determined. For the time constants τ, values up to $\tau < 0.3$ nsec were measured in photodiodes and $\tau < 10$ nsec in photoresistors. The measurement technique developed permits the temperature determination of plasmas that are optically dense in the infrared. (tr-auth)

51625 RATE OF QUENCHING OF METASTABLE HELIUM ATOMS IN THE POSITIVE COLUMN OF A GAS DISCHARGE. Tolmachev, Yu. A. Opt. Spectrosc. (USSR) (Engl. Transl.), 25: 261-2(Sept. 1968).

Translated from Opt. Spektrosk., 25: 470-2(Sept. 1968).

A study of the dependence of the populations of helium levels on the concentration of normal atoms of neon in He–Ne mixtures was used to determine the rate of quenching of metastable atoms in pure helium. The experiments were conducted with an 8-mm-diameter discharge tube, 90-mm long, filled with helium at pressures from 0.5 to 8.0 torr, and into which neon could be bled at pressure up to 0.1 P_{He}. (M.H.R.)

51626 MEASUREMENT OF SHORTING CURRENTS FROM A THETA-PINCH PLASMA. Thomas, K. S. (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. Lett., 23: 746-9(Oct. 6, 1969).

Shorting currents from a theta-pinch plasma were measured by observing the azimuthal magnetic field, B_θ, outside the compression coil. The total current and the radial distribution of the current agree well with values predicted by a theoretical rigid-rotor model. (auth)

51627 3s–3p TRANSITIONS OF Ne VII AND Ne VIII. Johnston III, W. D.; Kunze, H.-J. (Univ. of Maryland, College Park). Astrophys. J., 157: 1469-70(Sept. 1969).

The transitions 3s–3p of Ne VII and Ne VIII were identified in a high-temperature plasma produced in a theta-pinch discharge. (auth)

51628 EXPERIMENTAL INVESTIGATION OF HIGH FREQUENCY INSTABILITY OF AN ION BEAM INTERACTING WITH AN ELECTRON BACKGROUND. Chernov, Z. S.; Voronov, P. S.; Ovchinnikova, N. A.; Bernashevskii, G. A. (Inst. of Radio Engineering and Electronics, Moscow). Zh. Eksp. Teor. Fiz., 57: 725-9(July 1969). (In Russian).

Interaction between a proton beam and electrons of the background that compensates the space charge of the beam is investigated experimentally. The electron velocities are of the order of thermal velocities and the ion beam is accelerated by a voltage of several tens of kilovolts. It is shown experimentally that, due to high-frequency instability arising in the ion beam, coherent oscillations in the direction of the beam can be amplified. (auth)

51629 MEASUREMENT OF THE ELECTRIC CONDUCTIVITY OF AIR FOR INCIDENT AND REFLECTED SHOCK WAVES BY THE ELECTRODE METHOD. Gorelova, M. A.; Gorelov, V. A.; Kil'dyushova, L. A. Teplofiz. Vys. Temp., 7: 18-24(Jan.-Feb. 1969). (In Russian).

A system of electrodes was used to measure the electric conductivity of air for the front of incident and reflected shock waves at temperatures of 4000 to 9000°K. The volt–ampere characteristic of the interelectrode interval was determined and the value of the effective thickness of the near-electrode layer was obtained by the method of equivalent capacity. The ion concentration in front of the shock wave was calculated from experimental results. (tr-auth)

51630 LOW-VOLTAGE KNUDSEN'S ARC IN A CESIUM–ARGON MIXTURE. Kucherov, R. Ya.; Tkeshelashvili, G. I.; Tskhakaya, V. K. Zh. Tekh. Fiz., 38: 1188-90(July 1968). (In Russian).

To improve the operation of a low-voltage arc, argon atoms are introduced into the discharge region. The large discrepancy in cross sections for ion and electron scattering enables one to form a medium essentially transparent to the electrons and opaque to the ions. Thus, the difficulty of ion recombination at the electrodes is reduced, and the ion concentration needed for space-charge neutralization is increased. The effects of partial pressure of argon were studied in a discharge gap with a length of 0 to 4 mm. It was found that pressure conditions could be established where discharge voltage–current characteristics did not change over the gap length of 0.7 to 4 mm. Addition of argon leads to a strong decrease of voltage needed to sustain the arc. This also leads to a current increase in the case where volume production of ions is absent. (ATD)

51631 CORRELATION OF LIGHT FLUCTUATIONS IN THE POSITIVE COLUMN OF AN ARGON DISCHARGE. Grabec, I.; Poberaj, S. (Jozef Stefan Nuclear Inst., Ljubljana, Yugoslavia). Plasma Phys., 11: 519-27(June 1969).

The correlation coefficient of light fluctuations has been measured in an argon plasma in the positive column of a glow discharge at gas pressures between 0.02 and 0.08 torr and at discharge currents from 10 to 100 mA. At such conditions there are no stationary striations. The mean frequency and mean wavelength of the fluctuations are determined from correlation functions measured at zero time delay and at zero distance between sensors respectively. It has been found that the maximum of the correlation envelope moves towards the anode. The velocity of this movement has been determined. As some critical gas pressure at constant discharge current is approached all these quantities change sharply and well observed ionization waves appear. (auth) (UK)

51632 MOTION AND POLARIZATION INTERACTION OF A PLASMA FLOW IN A MAGNETIC FIELD OF A MULTIPOLE. Zykov, V. G.; Pashchenko, A. V.; Stepanenko, I. A.; Tolok, V. T. (Kharkov Inst. of Physics and Tech.). Zh. Tekh. Fiz., 38: 1217-21(Aug. 1968). (In Russian).

An investigation was made of the mechanism of plasma capture in an octupole magnetic field produced by four parallel conductors carrying current in the same direction. A plasmoid of density 10^{13} to 10^{14} cm^{-3} and velocity 3×10^6 cm/sec was injected from a conical source perpendicular to the magnetic field. The tests consisted of probe measurements of the ion currents in the plasma and in different directions. In some experiments, partitions were placed in the chamber to restrict the motion of the plasma along the magnetic field lines. Results showed that an important role in the capture of the plasma under the indicated condition is played by the polarization interaction between the plasma moving along the force lines and the plasma moving across the magnetic field. The effect of deceleration of the plasma and its capture depends strongly on the magnitude of the magnetic field. The length of the plasmoid can be varied in a given setup by means of a suitable choice of the magnetic field intensity and by regulating the difference of the plasma paths along and across the force lines of the magnetic field by suitably rearranging the positions of the parallel conductors. The experiments have also demonstrated the possibility of obtaining short plasmoids by the method described. (ATD)

51633 POSSIBILITY OF REMOVING IMPURITIES FROM A HYDROGEN PLASMOID BY INJECTION TRANSVERSELY TO AN OCTUPOLE MAGNETIC FIELD. Zykov, V. G.; Pashchenko, A. V.; Stepanenko, I. A.; Tolok, V. T. Zh. Tekh. Fiz., 38: 1222-9(Aug. 1968). (In Russian).

The possibility of clearing plasmoids injected from a coaxial source transversely to an octupole magnetic field produced by four rods carrying current in the same direction was investigated. Measurements of the mass composition and of the energy spectrum of the plasmoids with the aid of a time-of-flight mass spectrometer show that relatively dense hydrogen plasmoids can pass through the octupole magnetic field, but the octupole magnetic field cuts off the slow part, which consists essentially of the heavy ions from the plasmoid. It is also shown that the transmitted short plasmoid contains an appreciable amount of hydrogen ions, and also high-energy impurity ions with medium masses. The degree of the plasmoid passage through a given magnetic field intensity decreases with increasing density and with increasing hydrogen ion energy. Simultaneously, the octupole magnetic field operates like a filtering system, which yields sufficiently short hydrogen plasmoids with small content of heavy-ion impurity. The octupole magnetic field can therefore be used to clear plasmoids, but the method has shortcomings in that the density of the hydrogen plasmoid decreases with increasing magnetic field, and the octupole system cannot eliminate those ion impurities whose translational velocity is close to that of the hydrogen ions. (ATD)

51634 INFLUENCE OF HALL CURRENTS ON THE PLASMOID DYNAMICS IN A SPATIALLY PERIODIC MAGNETIC FIELD.

Kalmykov, A. A.; Tereshin, V. I.; Chebotarev, V. V. (Kharkov Inst. of Physics and Tech.). Zh. Tekh. Fiz., 38: 1230-8(Aug. 1968). (In Russian).

The interaction of plasmoids with a spatially periodic magnetic field produced by a system of coaxial coils in which the currents alternate in direction is considered. It is shown that such a system is the analogue of high frequency plasma confinement, being determined by the rate of the translational motion of the plasma and by the spatial period of the magnetic field. The experiments show that such a system makes it possible to realize focusing and stabilization of the motion of plasmoids, but there are noticeable energy losses from the plasma due to the penetration of the magnetic field into the plasma and further escape of the particles along the force lines to the chamber walls. The anomalous penetration of the magnetic field in the plasma is due to nonlinear effects connected with Hall currents. It is shown that short circuiting of the Hall currents occurs within the limits of the plasma stream and is determined by the appreciable inhomogeneity of the different parameters of the plasma along the plasmoid. (ATD)

51635 LONGITUDINAL POLARIZATION OF A PLASMA STREAM IN A TRANSVERSE MAGNETIC FIELD. Khizhnyak, N. A.; Demidenko, I. I.; Lomino, N. S.; Padalka, V. G. (Kharkov Inst. of Physics and Tech.). Zh. Tekh. Fiz., 38: 1239-50(Aug. 1968). (In Russian).

The occurrence of longitudinal polarization on the front of a plasma stream interacting with a transverse magnetic field was investigated. It is shown that a vibrational structure of the electric potential and of the magnetic field is produced behind the front of the plasma stream. The oscillations of the electric potential have a frequency close to the ion plasma frequency. The relaxation length of these oscillations and the thickness of the leading front of the polarization are estimated. The longitudinal polarization on the front of a plasmoid moving across an inhomogeneous magnetic field is investigated experimentally. The plasma density on the front of the plasmoid is estimated from the frequency of the observed potential oscillations, and the results agree sufficiently well with measurements of density with the aid of a screened electric probe. A drift of the frontal part of the plasmoid under the influence of the electric field of longitudinal polarization and a magnetic field perpendicular to it are observed. (ATD)

51636 MICROWAVE RADIATION FROM PLASMA OF REFLECTED DISCHARGE IN INHOMOGENEOUS MAGNETIC FIELD. I. RADIATION OF ELECTRON CYCLOTRON FREQUENCY HARMONICS. Dushin, L. A.; Kuznetsov, Yu. K.; Pavlichenko, O. S. (Kharkov Inst. of Physics and Tech.). Zh. Tekh. Fiz., 38: 1250-8(Aug. 1968). (In Russian).

It is shown that the presence of even weak mirrors can lead to an appreciable change of the character of the radiation, compared with experiments performed in a homogeneous magnetic field. Results are given of an investigation of the radiation at the harmonics of the electron cyclotron frequency $\omega = n\omega H$ ($n = 1, 2, 3, \ldots$). The polarization of the radiation is investigated; it is shown that in order for radiation to occur it is necessary that there exist a layer of hybrid resonance for a reception frequency $\omega = (\omega_0^2 + \omega_H^2)$. An attempt is made to explain the features of the experiments on the radiation of harmonics ω_H from a plasma of a reflection discharge on the basis of the available theoretical data on the instability of plasma waves near the harmonics. (ATD)

51637 INVESTIGATION OF THE ARC IN ARGON AT HIGH PRESSURE. Golubev, V. A.; Klimkin, V. F. (Moscow Aviation Inst.). Teplofiz. Vys. Temp., 6: 773-8(Sept.-Oct. 1968). (In Russian).

Results are given of an experimental investigation of the electric and thermal properties of the arc and the optical properties of argon at axial temperatures from 11 to 12×10^3°K and pressures of 10^5 to 10^7 n/m^2. The measured integral intensity of radiation compared favorably with the theoretical data. (tr-auth)

51638 DETERMINATION OF THE EMISSIVE POWERS OF AIR, N_2, AND CO_2 AT A TEMPERATURE OF ~ 10,000°K. Ogurtsova, N. N.; Podmoshenskii, I. V.; Shelemina, V. M. Teplofiz. Vys. Temp., 6: 788-93(Sept.-Oct. 1968). (In Russian).

A vortex-stabilized arc was used for drawing plasmas through the electrodes and, hence, excluding most of the electrode material in the channel. An arc source for obtaining a homogeneous column of pure gaseous plasma was designed. Spectra in the range 0.2 to 3μ were measured, integrated according to the spectra of the emissive powers of air, N_2, and CO_2. Measurement was accomplished at atmospheric pressure and temperatures of ~ 10,000°K. For the discharge in air, contribution of radiation of the separate spectral fields to the integral radiation of the plasma was established. (tr-auth)

51639 EFFECTIVE RESISTANCE BETWEEN COLD ELECTRODES IN SHOCKED ZENON PLASMA. Enomoto, Yuji; Hashiguchi, Seishiro; Goda, Noriaki (Hiroshima Univ.). Jap. J. Appl. Phys., 8: 1270(Oct. 1968).

The effective electric resistance was measured using a 4-cm-dia pressure-driven shock tube with Xe gas and an electric potential produced by plasma motion in a magnetic field. Measurements were made for initial pressures of 1 and 2 torr, shock Mach numbers of 9 to 13.2, magnetic fields up to 4700 G, and current densities from 10^{-2} to 2 A/cm^2. The plot of the resistance R_E vs current density J show two regions: (1) R_E is independent of J over 0.2 to 2 A/cm^2, and (2) for $J \leq 0.2$ A/cm^2, R_E decreases with J. This may be explained by the equation $R_E = R_{PL} + R_B + V_S/JA$, where R_{PL} = plasma resistance, R_B = boundary layer resistance, V_S = sheath voltage, and A = electrode area. Good agreement is obtained for $V_S = 1.5$, 1, and 0.5 V. (D.L.C.)

51640 TIME CONSTANT MEASUREMENTS OF HIGH-PRESSURE ARC COLUMNS. Edels, H.; Graffmann, E. (Liverpool Univ.). Z. Phys., 228: 396-415(1969).

Measurements have been made of the column field strength response to step current disturbances of high pressure arcs for currents of 4 to 40 amps in air, nitrogen, oxygen, and argon. The influence of current step amplitude has been taken into account and the results used to derive the conductance time constant values of free recovery. The measured steady state and transient properties agree in general with the properties predicted for an arc column dominated by thermal conduction loss. The results clearly show the development of arc cores with current increase. (auth)

51641 EXCITATION OF HIGHER STATES OF HELIUM IN THE POSITIVE COLUMN OF A DISCHARGE PLASMA. Tolmachev, Yu. A. Opt. Spectrosc. (USSR) (Engl. Transl.), 25: 262-4 (Sept. 1968).

Translated from Opt. Spektrosk., 25: 473-5(Sept. 1968).

Some conclusions are presented about the mechanism by which excited states of the helium atom (n = 3 and n = 4) are populated in the positive column of a dc gas discharge. These conclusions arise from an analysis of the dependence of the populations on the conditions of measurement. The absolute intensities of lines originating at the above levels were measured using an 8-mm-diameter tube with an incandescent tantalum cathode. (M.H.R.)

51642 THREE-DIMENSIONAL MOTION OF PLASMA IN HOMOPOLAR DEVICES. Gannitskii, A. I.; Drobyshevskii, E. M.; Rozov, S. I. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekh. Fiz., 38: 2070-2(Dec. 1968). (In Russian).

Secondary streaming was observed in a weakly ionized viscous gas in homopolar meridian planes that influence the velocity of the basic azimuthal flow. The secondary streaming may be induced by centrifugal forces or by the nonhomogeneous distribution of axially directed discharge current densities. The three-dimensional viscous flow of a gas-discharge plasma was studied, using the installation described by K. V. Donskoi et al. (Zh. Tekh. Fiz., 35: 84 (1965)). The results show that secondary flow considerably reduces the maximum flow, but the velocity distribution profile is more saturated. (R.V.J.)

51643 MOTION OF A PLASMA JET IN A TOROIDAL PLASMA WAVEGUIDE WITH ROTATION ANGLE 10°. Ivanovskii, M. A. (Lebedev Inst. of Physics, Moscow). Zh. Tekh. Fiz., 38: 1454-64(Sept. 1968). (In Russian).

An experimental investigation was made of the conditions under which an extended plasma jet can be regarded as isolated from the side walls and the ends of a toroidal plasma guide. A comparison is made of the observed drift velocity across the field with the calculated theoretical velocity, with allowance for the distribution of the plasma density and the ion velocities along the jet. The plasma jet was obtained compressing the plasma with an axially symmetric quasi-constant field at the entrance to the solenoid, where the plasma was in contact with the wall. The angle of plasma rotation was chosen to be 10°, and the length of the section of the field before the rotation as well as the conditions at the input of the plasma jet, were varied. The degree to which the observed drift velocity of the plasma approaches the theoretical calculated value served as a criterion of the degree to which the experimental conditions were close to ideal. From the agreement between the results of measurements with the aid of an electrostatic probe and a luminescent screen, it is concluded that the presence of a toroidal metallic surface along the path of the plasma does not influence the velocity of the transverse displacement of the plasma. The experiment has also shown that the drift velocity does not depend on the magnetic field, provided the dielectric constant is much larger than unity, and the transverse motion of the plasma consists of parallel transport of the entire plasma jet across the field. (ATD)

51644 SOME OBSERVATIONS OF A CONICAL Z-PINCH DISCHARGE. Pert, G. J. (Univ. of Alberta, Edmonton). Plasma Phys., 11: 565-78(July 1969).

Observations of the discharge in a conical Z pinch in hydrogen indicate that the plasma blob is formed partly from gas accelerated axially by the two-dimensional nature of the discharge and partly by ejection of particles from the central column of the pinch formed. A snowplough calculation of the dynamics of the collapse shows reasonable agreement with experiment. (auth) (UK)

51645 MEASUREMENTS OF THE ELECTRON DRIFT VELOCITIES IN A CESIUM DISCHARGE. Postma, A. J. (FOM-Instituut voor Plasma-Fysica, Jutphaas, Netherlands). Physica, 44: 38-50(Sept. 8, 1969).

In the positive column of a discharge in cesium vapor the electron density was measured as a function of the discharge current and the gas pressure. At small values of the reduced electric field strength, the electron drift velocities calculated from these measurements are in good agreement with the theoretically predicted ones over a large range of ionization degrees. At large reduced field strength the theoretical values are a factor two larger. The electron density was measured with a microwave cavity. The relation between frequency shift and electron density was calculated, taking into account the influence of the wall of the discharge tube and of the radial distribution of the electrons over the tube cross section. (auth)

51646 DETERMINATION OF TRANSITION PROBABILITIES FOR SOME O I LINES. Goly, A. (Higher Pedagogical Coll., Opole, Poland). Acta Phys. Pol., 36: No. 1, 33-9(July 1969).

Using a wall-stabilized cascade arc, a plasma of temperature of 11,780°K was produced in an argon–oxygen mixture under atmospheric pressure. The transition probabilities for eight lines of neutral oxygen were determined under the assumption that the plasma is optically thin and is in local thermodynamic equilibrium. The results are in satisfactory agreement with the experimental data of other authors, as well as with the results obtained by Bates and Damgaard by means of theoretical calculations. (auth)

Kinetics (Theoretical)

Refer also to abstracts 51315, 51821, and 51826.

51647 (CEA-CONF-1396) COLLISIONAL-RADIATIVE IONIZATION AND RECOMBINATION COEFFICIENTS FOR HELIUM PLASMAS. Drawin, H. W.; Emard, F.; Tittel, H. O. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). [1969]. 4p. (CONF-690803-22). Dep. CFSTI (U. S. Sales Only).

From 9th International Conference on Phenomena in Ionized Gases, Bucharest, Romania.

The coefficients α (recombination) and S (ionization coefficient) have been calculated for a helium plasma covering the range from very low to very high densities. The singlet and the triplet system have simultaneously been taken into account, the coupling of the two-level systems accomplished by radiative processes (intercombination lines), electronic collisions, and collisions with neutral atoms. (M.O.W.)

51648 (CEA-CONF-1399) NON-MARKOVIAN IMPACT THEORY. Voslamber, Dietrich (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). [1969]. 4p. (CONF-690803-30). Dep. CFSTI (U. S. Sales Only).

From 9th International Conference on Phenomena in Ionized Gases, Bucharest, Romania.

A brief theoretical analysis that takes account of the non-Markovian character of the broadening process in plasma is presented. (M.O.W.)

51649 (CLM-R-96) ON STRONG TRANSVERSE MAGNETOGASDYNAMIC SHOCK WAVES. Woods, L. C. (United Kingdom Atomic Energy Authority, Abingdon (England). Culham Lab.). May 1969. 19p. Dep. CFSTI (U. S. Sales Only). UK 3s. 0d.

The structure of strong transverse MHD shock waves was studied, using a two-fluid ($T_i \neq T_e$) model. Thermoelectric effects and the temperature dependence of the transport coefficients are taken into account and a semi-empirical modification of the ionic transport coefficients that permits the ions almost collisionless behavior in the center of the shock is given. A detailed comparison between experiment and theory for shocks at Alfvén Mach numbers of 2.5 and 3.7 is made. The main conclusion is that a theory that uses the usual or "classical" transport coefficients derived from kinetic theory, predicts shocks too thin by nearly an order of magnitude. To achieve the experimental thickness it is necessary to increase the classical resistivity about ten times, leaving the viscosity and thermal conductivities unchanged. An expression for anomalous resistivity, recently derived by the author from a temperature gradient instability, when used in place of the classical resistivity in the shock structure equations, yields profiles whose shape is in fair agreement with experiment. The theory also predicts downstream values of the temperature ratio, T_e/T_i, to be 10 or more, which appears to agree with experiment. (auth) (UK)

51650 (JPRS-46949, pp 23-32) PENETRATION OF A LONGITUDINAL ELECTRIC FIELD INTO A SEMICONFINED PLASMA. Dryakhlushin, V. F.; Romanov, Yu. A. Translated from Zh. Tekh. Fiz., 38: 1442-8(1968).

The penetration of a longitudinal electric field into a semiconfined homogeneous plasma with diffuse reflection of the plasma particles from its boundary is investigated in the kinetic approximation. The results obtained are compared with the previous results, where the analogous problem is investigated under the condition of mirror reflection of the plasma particles from the plasma boundary. Comparison shows that the nature of penetration of the longitudinal field into the plasma depends essentially on the specific law of interaction of the plasma particles with its surface only in the low-frequency range ($0 \leq \omega - \omega_{0i}$; ω_{0i} is the Langmuir ion frequency); in the rest of the range this dependence turns out to be insignificant. The causes for this behavior are discussed. (tr-auth)

51651 LIE-ADMISSIBLE MODEL FOR DISSIPATIVE PLASMAS. Roman, P.; Santilli, R. M. (Boston Univ.). Nuovo Cim., Lett., 2: 449-55(Sept. 21, 1969).

A model for dissipative plasmas was constructed in terms of an elementary generalization of well-known basic equations for plasma physics to dissipative conditions. The Liouville equation for a conservative system is used. (M.O.W.)

51652 SHOCK WAVES IN COLLISIONLESS PLASMA. Tidman, D. A. (Univ. of Maryland, College Park). pp 229-35 of Plasma Instabilities in Astrophysics. Wentzel, Donat G.; Tidman, Derek A. (eds.). New York, Gordon and Breach, Science Publishers, Inc., 1969.

From International Conference on Plasma Instabilities in Astrophysics, Pacific Grove, Calif. See CONF-681042.

Theoretical models for collisionless shock waves that have appeared in the literature are briefly reviewed. (M.O.W.)

51653 ANOMALOUS SCATTERING AND PHASE FOCUSING OF A MODULATED ELECTRON BEAM IN A PLASMA. Gabovich, M. D.; Kovalenko, V. P. (Inst. of Physics, Kiev). Zh. Eksp. Teor. Fiz., 57: 716-24(July 1969). (In Russian).

It is shown that by introducing an initial velocity modulation of electrons, the phenomenon of anomalous scattering of an electron beam in a plasma can be reproduced. Anomalous scattering of modulated as well as of unmodulated beams may be explained if plasma–beam interaction and klystron grouping are taken into account simultaneously. (auth)

51654 DETERMINATION OF THE PROFILE OF ELECTRIC CONDUCTIVITY ACCORDING TO CHANGES OF PARAMETERS OF THE CONTOUR. Poberezhskii, L. P. Teplofiz. Vys. Temp., 7: 25-33(Jan.-Feb. 1969). (In Russian).

The question of finding the radial distribution of electric conductivity of an axially symmetric plasma flow is considered theoretically on the basis of variations of parameters and inductance of the contour coaxial to the flow. (tr-auth)

51655 RADIATIVE COOLING OF DENSE HYDROGEN PLASMA. Goncharova, G. I. Teplofiz. Vys. Temp., 7: 6-12 (Jan.-Feb. 1969). (In Russian).

The cooling of a confined plasma of hydrogen isotopes with a density of 1.45×10^{-7} to 5.9×10^{-5} g/cm^3 was calculated in the temperature range 10 to 0.8 eV assuming that the path of the radiation in the plasma exceeds or equals the dimension of the plasma. Results of the estimate were compared with experimental values obtained by observation of the initial stage of cooling of a dense deuterium plasma, previously heated by the ohmic method. (tr-auth)

51656 MATERIAL COEFFICIENTS AND TRANSFER OF POLARIZED RADIO RADIATION IN A PLASMA. Heyvaerts, J. (Institut d'Astrophysique, Paris). Astrophys. Space Sci., 5: 36-52(Sept. 1969).

By a perturbation and diagram resummation method, a transport equation for the transverse field polarization matrix is established. This equation is then transformed into an equation for the Stokes parameters of the radiation. The equation takes the usual form of a transfer equation; the absorption and emission coefficients are matrixes, the elements of which are given as a function of the dissipative part of the microcurrent correlation tensor and conductivity tensor. Finally this equation is expressed as a system for the intensities of the proper modes. The equations of the system are usually coupled. (auth)

51657 ENERGY LEVELS IN THE DEBYE FIELD. Schlueter, D.; Tsoi, S. K. (Sternwarte Bergedorf, Hamburg). Astron. Astrophys., 3: 147-9(Oct. 1969).

The energy levels of an electron in a Debye field have been repeatedly investigated by various authors because of their significance for the calculation of the ionization potential and the partition function in a plasma. Whereas according to Bonch-Breuvich and Glasko the number of energy levels is finite, Rouse maintains that there are at least as many as a "pure" Coulomb field would yield, viz., infinite. By numerical integration of the Schrödinger equation the energy levels were located and the results of Bonch-Breuvich and Glasko were confirmed. (auth)

51658 LOW FREQUENCY PROPERTIES OF A WEAKLY TURBULENT PLASMA IN THE CASE OF FREQUENT COULOMB COLLISIONS. Makhan'kov, V. G.; Shchinov, B. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksp. Teor. Fiz., 57: 877-84(July 1969). (In Russian).

The nonlinear tensor of the dielectric permeability of a weakly turbulent plasma in the range of frequent Coulomb collisions is derived on the basis of hydrodynamic equations. It is shown that in this frequency range new unstable vibration branches (of the type of second sound) may appear. The instability condition of the vibrations in this case are much less stringent than in the case of excitation of ion sound in a collisionless plasma. (auth)

51659 NONLINEAR THEORY OF INTERACTION BETWEEN A "MONOCHROMATIC" BEAM OF RELATIVISTIC ELECTRONS AND A PLASMA. Fainberg, Ya. B.; Shapiro, V. D.; Shevchenko, V. I. (Physical-Technical Inst. of Low Temperatures, Kharkov). Zh. Ekspl Teor. Fiz., 57: 966-77(July 1969). (In Russian)

Excitation of oscillations as a result of interaction between a relativistic "monochromatic" beam and plasma is considered in the quasilinear approximation. Variation of the beam distribution function is found, and the energy of the oscillations excited and the characteristic time for transfer of energy from the beam to the oscillations are determined. It is demonstrated that in going over to a relativistic beam the fraction of energy used to excite oscillations in the hydrodynamic stage, when the increments are sufficiently large, considerably increases. (auth)

51660 THEORY OF THE ELECTRICAL CONDUCTIVITY OF A WEAKLY IONIZED IMPERFECT PLASMA. Yakubov, I. T. (Inst. of High Temperature, Moscow). Zh. Eksp. Teor. Fiz., 57: 1040-6(July 1969). (In Russian).

The electric conductivity coefficient of a weakly ionized plasma is expanded into a series in powers of the neutral component concentration N: $\sigma = \sigma_0 (1 + c_1 N + c_2 N^2 + c_3 N^2 \ln N)$, where σ_0 is the electrical conductivity in the Lorentz approximation. The corrections to σ_0 take into account nonideality effects. (auth)

51661 CONDUCTIVITY OF LOW-TEMPERATURE PLASMA. Kalitkin, N. N. (Inst. of Applied Mathematics, Moscow). Teplofiz. Vys. Temp., 6: 801-4(Sept.-Oct. 1968). (In Russian).

The transport properties of a multicomponent plasma were calculated. Quantum-mechanical scattering cross sections at the Debye potential in the Born approximation were used in the calculations. Results are applicable for arbitrary temperatures and not too-high densities, and are represented by simple formulas, which become known expressions for Lorentz gases at high temperatures. (tr-auth)

51662 THEORY OF VIBRATIONAL RELAXATION OF DIATOMIC MOLECULES. Kuksenko, B. V.; Losev, S. A. (Moscow State Univ.). Teplofiz. Vys. Temp., 6: 794-800(Sept.-Oct. 1968). (In Russian).

The numerical solution of the problem concerning the excitation of oscillations of diatomic molecules during atom-molecule collisions in gases was investigated. A mixture of O_2 and Ar in the temperature range 10^3 to 2×10^4°K was investigated. Lifetime calculations were made for the vibrational relaxation. The results were compared with shock tube experiments. (tr-auth)

51663 DIFFUSION ACCUMULATION OF PLASMA IN STEADY FLOW. Konenko, O. R. (All-Union Electrotechnical Inst., Moscow). Teplofiz. Vys. Temp., 6: 784-7(Sept.-Oct. 1968). (In Russian).

The phenomena of increased concentration of plasma in steady un-ionized flow were discovered, and explained from the point of view of diffusion caused by the combined action of concentration gradients of plasma and electron temperature. The possibility of its use for conductivity enhancement is indicated. The limits of its existence in relation to the charged-particle concentration are evaluated. (tr-auth)

51664 NONLINEAR ELECTRIC CONDUCTIVITY OF A LORENTZIAN PLASMA SUBJECT TO THE ACTION OF A FREQUENCY-MODULATED ELECTRIC FIELD. Allouche, Daniel; Jancel, Raymond; Kahan, Theo (Institut Henri Poincare, Paris). Compt. Rend., Ser. B, 269: 49-51(July 16, 1969). (In French).

An expression is given for the electric conductivity of a Lorentzian plasma subject to the action of two superimposed electric fields, one of which is frequency-modulated. Thus, the existence of various nonlinear effects is shown. (J.F.P.)

51665 THEORY OF THE QUANTUM PLASMA WITH USE OF THE METHOD OF COLLECTIVE VARIABLES. Yukhnovskii, Igor Rafailovich (Ivan-Franko-Univ., Lvov); Hetzheim, Hartwig. Wiss. Z. Univ. Rostock, Math.-Naturwiss. Reihe, 16: 849-56 (1967). (In German).

An approach to the equation of state of a fully ionized plasma, incompletely defined previously because of difficulties associated with quantum corrections, is made. The method of collective variables is particularly valuable when exchange effects in a quantum plasma are considered. The operator exp $(-\beta H)$ is reduced to the form (exp U) σ, where β is inversely proportional to temperature and H is the Hamiltonian; U is a symmetrical function and σ is the unsymmetrical operator. After a change to collective variables, equations for U and σ are obtained. It is then possible to calculate the free energy of an electron gas at high temperatures. Equations for calculation of exchange effects and of the second virial coefficient are derived. A pseudopotential $U'(r)$ is obtained. Exchange effects give different contributions to the term proportional to s in the free energy. (BBB)

51666 HYDRODYNAMIC APPROXIMATIONS FOR STRONGLY IONIZED PLASMAS WITH CONSIDERATION OF POLARIZATION. Ulbricht, Heinz; Ebeling, Werner (Univ., Rostock, Ger.). Wiss. Z. Univ. Rostock, Math.-Naturwiss. Reihe, 16: 857-68(1967). (In German).

Manipulations of the particle distribution function in phase space describing the state of a fully ionized plasma are described. The kinetic equations of Lenard and Balescu are reviewed, and an extension of them to the inhomogeneous case is provided. Equations are also derived for coefficients of an expansion of the distribution functions through Hermitian polynomials in velocity space. Explicitly closed functions are established for the approximations introduced by Grad for the 13-moment and the 20-moment. The collision integrals are approximately evaluated using the derived 13-moment approximation. Inhomogeneity is approximated in the collision integral by an additive non-local contribution in addition to the collision integral for weak inhomogeneous plasmas of Balescu. (BBB)

51667 DRIFT DISSIPATIVE PLASMA INSTABILITY IN DISCHARGE WITH OSCILLATING ELECTRONS. Brzhechko, L. V.; Kuznetsov, Yu. K.; Pavlichenko, O. S. Zh. Tekh. Fiz., 38: 1293-8(Aug. 1968). (In Russian).

Data obtained on low-frequency potential plasma oscillations in a discharge with oscillating electrons showed that the behavior of the observed oscillations is well described by the theory of drift-dissipative instabilities of inhomogeneous weakly ionized plasma. Cathode ion layers contribute significantly to the excitation of oscillations. The experiments were carried out in a hydrogen plasma column 60 cm long and 4 cm in diameter, with pressure of 5×10^{-4} to 5×10^{-2} mm Hg and with parameters of $n_i = n_e \approx 10^{12}$ cm^{-3}, $T_e \approx 20$ to 30 eV, and $T_i \approx 0.3$ to 0.5 eV. (R.V.J.)

51668 CALCULATIONS OF ELECTRON TEMPERATURE ACROSS A SHOCK WAVE OF A PARTIALLY IONIZED GAS. Kamimoto, Goro; Nishida, Michio; Inui, Toshiyuki. Nippon Koku Gakkaishi, 17: 227-35(1969). (In Japanese).

The electron temperature profile across a normal shock wave in weakly ionized nonequilibrium Ar was calculated by the numerical integration of the energy conservation equation of the electrons using the Mott-Smith solution for the ions and the atoms. Assuming the chemical reaction is frozen, this problem was analyzed at several values of the electron-massive particle temperature ratio ahead of the shock wave by two methods; that is, by extending the approximate method of Grewal et al., and by integrating directly the energy conservation equation of the electron using a trial method. The profiles of the electron temperature obtained by these two methods agreed with each other. To examine the effect of recombination on electron temperature profile across a shock wave, the electron energy equation was numerically integrated, with the assumption that the relevant recombination process is the electron-electron-ion three-body recombination. (BBB)

51669 INHERENT QUASI-STATICAL OSCILLATIONS OF PLASMOIDS. Levin, M. L.; Muratov, R. Z. (Radiotechnical Inst., Moscow). Zh. Tekh. Fiz., 38: 1999-2001(Nov. 1968). (In Russian).

A simple method is suggested for finding radiation attenuation constants for quasi-static inherent oscillations of plasma clusters. The method does not require solution of the boundary problem

for the wave equation and takes into account the influence of impurities distributed at greater distances in comparison to the dimensions of the cluster. (R.V.J.)

51670 THEORY OF OSCILLATIONS OF PLASMA SITUATED IN CONSTANT MAGNETIC AND HIGH-FREQUENCY ELECTRIC FIELDS. Domrin, V. I. (Lebedev Inst. of Physics, Moscow). Zh. Tekh. Fiz., 38: 1856-68(Nov. 1968). (In Russian).

Potential oscillations of neutral completely ionized magneto-active plasma placed in a high-frequency electric field were studied. It was shown that the high-frequency field changes the existing oscillation branches and results in the appearance of new ones. It is also shown that the external high-frequency field resulted in many instances, in additional oscillation damping. (tr-auth)

51671 LOW-FREQUENCY RESONANT ELECTRIC OSCILLATIONS IN THE FLOW OF NONISOTHERMAL PLASMA. Kubarev, Yu. V.; Kotel'nikov, V. A. (Moscow Aviation Inst.). Zh. Tekh. Fiz., 38: 1869-71(Nov. 1968). (In Russian).

Low-frequency electric oscillations were studied in a jet of nonisothermal plasma flowing from a source similar to a Penning source, but differing by the absence of an anticathode and the irregularity of the magnetic field. The studies were carried out in the pressure range of 5×10^{-2} to 1 n/m^2 and magnetic fields of 0 to 8×10^4 A/m with the frequency of the oscillations varying from 5 to 150 kHz. Graphical data are presented. (R.V.J.)

51672 MOTION OF CHARGED PARTICLES IN A SELF-CONSISTENT STANDING POTENTIAL WAVE. Best, R. W. B. (FOM-Instituut voor Plasma-Fysica, Jutphaas, Netherlands). Physica, 44: 227-40(Sept. 15, 1969).

An asymptotic solution of the equations of Vlasov and Poisson describing one-dimensional plasma motion is discussed. The self-consistent, nonexternal, potential is in lowest order a standing wave. The solution involves expansions in the wave amplitude. Higher-order coefficients of the potential series are expressed in terms of the distribution function, which is a function of one constant of motion only, obtained by integrating once the equation of motion. The omission of a second integration, and the associated constant of motion, amounts to an assumption of random phases. The wave is shown to be stable. (auth)

51673 NUMERICAL STUDIES OF THE RAREFIED-PLASMA INTERACTIONS AT MESOTHERMAL SPEEDS. Jew, Howard. Ann Arbor, Mich., Univ. of Michigan, 1968. 135p.

Thesis.

The purpose of this work was to study the rarefied-plasma interactions with a body moving at mesothermal speeds, where the moving body has speed which is larger than the thermal speed of the ions but smaller than the thermal speed of the electrons in the plasma. The primary objective was to determine, by an effective numerical method, the self-consistent-field solutions of the interaction problem in order to obtain the characteristics of the mesothermal near wake structure behind moving bodies. (Diss. Abstr.) (TSS)

Production

Refer also to abstract 51600.

51674 (CEA-CONF-1372) TIME RESOLVED TEMPERATURE IN SOLID DEUTERIUM LASER PRODUCED PLASMAS. Floux, F.; Cognard, D.; De Giovanni, G. (Commissariat a l'Energie Atomique, Villeneuve-Saint-Georges (France)). [1969]. 4p. (CONF-690803-23). Dep. CFSTI (U. S. Sales Only).

From 9th International Conference on Phenomena in Ionized Gases, Bucharest, Romania.

X radiation from the laser-irradiated plasma plasma passes through nickel or beryllium foils and is picked up by NE 102A plastic phosphors and 56 AVP Radiotechnique photomultipliers (rise time 2 ns). Time-resolved temperature diagrams are deduced from this data. (M.O.W.)

51675 (CEA-CONF-1376) COLLECTING AND COUNTING THE FIRST ELECTRONS PRODUCED IN A GAS BY A NON-FOCUSED LASER RADIATION. Blanc, A.; Guyot, D. (Commissariat a l'Energie Atomique, Villeneuve-Saint-Georges (France)). [1968]. 4p. (CONF-690803-18). Dep. CFSTI (U. S. Sales Only).

From 9th International Conference on Phenomena in Ionized Gases, Bucharest, Romania.

The experimental technique for detecting and counting the electrons is described. Data are given for density measurements in argon. (M.O.W.)

51676 (CEA-CONF-1390) LiH LASER PRODUCED PLASMAS. Mattioli, M.; Veron, D. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). [1969]. 4p. (CONF-690803-26). Dep. CFSTI (U. S. Sales Only).

From 9th International Conference on Phenomena in Ionized Gases, Bucharest, Romania.

Measurements performed on plasmas produced by irradiating a pellet of LiH isolated in vacuum with a giant pulse laser are described. It is shown, by using a 1-nsec rise-time laser pulse, that the mean expansion velocity of the isotopic plasma is about 2×10^7 cm/sec, that is to say 4 times greater than that obtained with a 30-nsec laser pulse. With the fast rising pulse the total number of atoms reaching a sphere of 10-cm radius is equal to 20% of the atoms of the initial pellet, and the ions are multiply charged. By adding a magnetic field the ion-electron recombination is reduced, and the mean velocity of the protons reaches 5×10^7 cm/sec. (M.O.W.)

51677 (CLM-R-98) THERMIONIC LITHIUM PLASMA SOURCE FOR DRIFT WAVE EXPERIMENTS. Burt, J.; Little, P. F.; Stott, P. E. (United Kingdom Atomic Energy Authority, Abingdon (England). Culham Lab.). Jan. 1969. 15p. Dep. CFSTI (U. S. Sales Only). UK 4s. 0d.

For experiments on drift waves in thermionic plasmas, it is important that the surface temperature of the ionizing plate should be carefully controlled in order to minimize the effects on the plasma of electric fields produced in the end plate sheaths. The ion Larmor radius may be made small by using a lithium plasma. Details are given of the design and construction of a source which has been used to produce a 5-cm-diameter column of lithium plasma at densities in the range 10^7 to 10^9 cm^{-3}. (auth) (UK)

51678 (WERL-3472-14) PLASMA PRODUCTION BY A HIGH-POWER Q-SWITCHED LASER. Final Report, February 1, 1968–January 31, 1969. Engelhardt, A. G.; George, T. V.; Pack, J. L.; Hora, H. (Westinghouse Research Labs., Pittsburgh, Pa.). Feb. 17, 1969. Contract AT(30-1)-3472. 54p. Dep. CFSTI.

The focused output beam of a Q-switched ruby laser having a power of 150 MW and an energy of 3 joules has produced plasmas from isolated single aluminum spheres 50 to 150 μm in radius. The plasma is probed by a second ruby laser beam possessing a pulse width of 20 nsec and total energy of 6 joules. When the peaks of the creating and probing pulses are 85 and 185 nsec apart, the spectral profiles of the light scattered at 90° are approximately gaussian and yield temperatures of 2.5 and 0.1 eV, respectively, 3.0 mm from the plasma center. Comparison with linear theoretical calculations based on the equations of motion and energy conservation indicates that the computed values are smaller by factors of 6 and 2, respectively. Possible causes for the disagreement are presented. A description is given of a multichannel spectrum analyzer recently completed, which will help in the resolution of the discrepancy in the scattering experiment. Finally, a specific nonlinear theory was used to explain certain aspects of the framing camera and energy absorption studies. The linear and nonlinear theories complement one another in furnishing a consistent explanation of plasma behavior. (auth)

51679 INVESTIGATION OF NEAR-ELECTRODE PLASMA-PRODUCED HIGH-CURRENT PULSE DISCHARGES WITH SEPARATED JETS AT ATMOSPHERIC PRESSURE. [PART] I. Grechikhin, L. I.; Davydov, B. B.; Min'ko, L. Ya. (Inst. of Physics, Erevan). Teplofiz. Vys. Temp., 6: 779-83(Sept.-Oct. 1968). (In Russian).

The near-electrode structure for plasma production was studied under conditions of division and flow of electrode jets. Certain peculiarities related to the interaction and mutual influence of the jets were examined. The hydrodynamic nature of the dark space, observed in the near-electrode areas of pulse discharges, was developed. By analogy with the physical processes of the flow of plasma jets under laser action on metals, conclusions are made concerning the essential role of magnetic pressure in the formation of electrode jets. (tr-auth)

51680 PARAMETERS OF PLASMA PRODUCED UNDER THE ACTION OF UHF POWER IN MAGNETIC FIELDS. I. STATIONARY REGIME. Anisimov, A. I.; Vinogradov, N. I.; Golant, V. E.; Nanobashvili, S. I.; Pakhomov, L. P. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekh. Fiz., 38: 1902-7(Nov. 1968). (In Russian).

Plasma produced by uhf 3-cm waves under conditions of electron cyclotron resonance was investigated. Pressures of 5×10^{-4} to 10^{-2} mm Hg were used and the uhf supply was 200 W. The stationary concentration of charged particles was in the range from 10^{11} to 10^{13} cm^{-3} and electron temperature from 1.5 to 15 eV. Experimental data were analyzed on the basis of balanced equations. (tr-auth)

51681 PARAMETERS OF PLASMA PRODUCED UNDER THE ACTION OF UHF POWER IN MAGNETIC FIELDS. II. PULSED REGIME. Anisimov, A. I.; Vinogradov, N. I.; Golant, V. E.; Nanobashvili, S. I.; Pakhomov, L. P. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekh. Fiz., 38: 1908-15(Nov. 1968). (In Russian).

Stationary plasma formed in a magnetic trap by uhf 3-cm waves under electron cyclotron resonance conditions was supplied with additional uhf pulses of approximately identical frequency but of considerably higher energy. The pulse duration was about 20 μsec with energy of 20 kW. The efficiency of the uhf energy absorption and the plasma parameters were estimated. (tr-auth)

Stability

Refer also to abstracts 51156, 51731, and 51868.

51682 (CLM-R-97) DYNAMIC STABILISATION OF UNSTABLE MHD EQUILIBRIA. A GENERAL APPROACH. Berge, G. (United Kingdom Atomic Energy Authority, Abingdon (England). Culham Lab.). May 1968. 58p. Dep. CFSTI (U. S. Sales Only). UK 8s. 0d.

The basic equations used in this work are the ideal MHD equations. A general theory is developed for investigating the stability of a plasma with an oscillatory motion. The oscillatory motion is assumed to be forced on the system and controlled from outside. It takes place around some equilibrium of the system. This equilibrium may be "weakly" unstable or only marginally stable. "Weakly" unstable in this context means that the characteristic frequency of any instability present in the static system must be much less than the frequency of the forced oscillations. The aim of the investigation is to determine whether the dynamic effect of such oscillations can improve the stability of the system. The first relevant equations obtained, result in stability conditions related to the energy principle for the static case. The results are not restricted to any particular geometry. The special case of a plasma separated from the vacuum region by a discontinuity surface is worked out. The problem of parametric resonance and associated instability is briefly discussed. (auth) (UK)

51683 (GA-9674) CONTROLLED THERMONUCLEAR RESEARCH PROGRAM. Summary Progress Report for the Period August 1, 1968-July 31, 1969. Ohkawa, T. (Gulf General Atomic, Inc., San Diego, Calif.). Sept. 15, 1969. Contract AT(04-3)-167. 72p. Dep. CFSTI.

The plasma instabilities are studied in both the octopole and quadrupole configurations. A typical set of parameters is plasma density 10^{10} cm^{-3}, ion temperature 100 eV, and electron temperature 10 eV. In both devices the difference of the vector potential between the separatrix and the wall or the stability limit corresponds to about five gyroradii for 100-eV hydrogen ions. In the octopole configuration, three types of fluctuations are recognized. The first type of fluctuation has a zero wave number parallel to the magnetic field and propagates along the diamagnetic current with a wave number comparable to the reciprocal of the ion gyroradii. The amplitude of the potential fluctuation is about 50 mV and increases rapidly as the octopole field is decreased. The fluctuation is suppressed by applying a toroidal field of a few gauss or by lowering the ion temperature. The results of the fluctuations measurement and the transmission experiment agree with the theoretical dispersion relation for drift cyclotron instability. The second type is observed at the plasma density below 3×10^{8} cm^{-3} with a toroidal field larger than 40 G. The mode is identified at the electron-driven drift cyclotron instability with finite parallel wave number. The third type is observed in the plasma with a density below 3×10^{-8} cm^{-3} only when the ion temperature is lowered. A toroidal field of a few gauss suppresses the fluctuation. The amplitude is approximately uniform, and no phase shift is observed along the magnetic line of force. This mode is interpreted as the ion-driven instability due to the modulation of the magnetic field along the line of force. Large-amplitude (20%) fluctuations are found inside the stability limit in the quadrupole device. The frequency spectrum is 10 to 500 kHz. The wave number parallel to the magnetic field line is zero. The phase velocity is in the direction of and less than the ion diamagnetic drift velocity. These characteristics are consistent with an interchange instability due to finite gyroradius of ions. The absence of this type of instability in the octopole device is expected from the theoretical theory. (auth)

51684 (NP-18032) INSTABILITY OF NONLINEAR PERIODIC WAVES IN A MEDIUM WITH DISPERSION. Preprint 253. Zaslavskii, G. M.; Filonenko, N. N. (Akademiya Nauk SSSR, Novosibirsk. Institut Yadernoi Fiziki). 1968. 23p. (In Russian). Dep. CFSTI (U. S. Sales Only).

The stability of solutions of a type of nonperiodic waves in the presence of a perturbation, the nature of which may be the heterogeneity and nonsteady-state nature of the medium, is discussed. The model of ion acoustics and the Korteweg-de Vries equation is investigated by way of an example. It is shown that an instability of the stochastic type exists for periodic waves sufficiently "close" to an isolated wave (i.e., with a very large period). The instability is manifest in the fact that the phase of the wave as a function of time becomes close to random and, as a result, a Brownian motion of the wave parameters arises in the corresponding phase space. The velocity of the waves begins, on the average, to grow with time and reaches a critical value at which a reversal occurs. An evaluation of the time during which the reversal arises is given in the ion-acoustics model. Conditions are given under which stochastic instability develops. (JPRS)

51685 (UR-3942-5) QUASILINEAR THEORY OF THE POSITIVE COLUMN SPIRAL INSTABILITY. Simon, Albert; Shiau, J. N. (Rochester Univ., N. Y.). [1968]. Contract AT(30-1)-3942. 38p. Dep. CFSTI.

An analysis of the nonlinear behavior of the spiral instability of the positive column is presented. The finite amplitude and frequency shift of the single mode which results from raising the magnetic field slightly above the critical value are determined. The slope of the E-H curve also is obtained. The method is based on a general theory of nonlinear behavior in weakly ionized plasma. The quasi-linear results are in excellent agreement with experiment. (auth)

51686 ENERGY CRITERION FOR STABILITY OF EQUILIBRIUM PLASMA GIVEN BY STATIONARY DISTRIBUTION FUNCTION. Lacina, J. (Inst. of Plasma Physics, Prague). Czech. J. Phys., B19: 1301-3(1969).

Using the variational method rigorously, criteria are derived for the stability of plasma (given by a stationary distribution function) in an external nonuniform magnetic field. These criteria hold quite exactly, in contrast to the many existing energy criteria which have not been derived rigorously. The criteria consider the nonlinear motion of particles in perturbed fields so that they are more general than those derived from linearized equations (e.g., from the linearized Vlasov equation). (M.O.W.)

51687 DISSIPATIVE INSTABILITY BASED ON TRAPPED PARTICLES IN A DENSE PLASMA. Kadomtsev, B. B.; Pogutse, O. P. Dokl. Akad. Nauk SSSR, 186: 553-6(1969). (In Russian).

If collisions are neglected, this instability is developed on chute perturbations of particles with a slight horizontal velocity, which are trapped between the magnetic mirrors of an inhomogeneous toroidal field. With increasing frequency of collisions the particles go from a trapped position to free flight, and the instability becomes dissipative. The presence of confined particles is essential. It is shown that at a sufficiently high frequency of electron collisions a new dissipative instability on trapped particles can develop, for which the presence or absence of trapped ions is immaterial, and which for this reason should be called an instability on trapped electrons. This stability is a variant of a drift-dissipative instability, in which the mechanism of dissipation leading to rolling of the drift waves involves the passage of electrons from trapped positions to free flight because of collisions. A strong horizontal magnetic field of the type found on Tokamak is assumed to be present. The coefficient of turbulent diffusion as a function of the frequency of electron collisions is given in graphical form. (TTT)

51688 TRAPPED-PARTICLE INSTABILITY. Kruer, W. L. (Princeton Univ., N. J.); Dawson, J. M.; Sudan, R. N. Contract AT(30-1)-1238. Phys. Rev. Lett., 23: 838-41(Oct. 13, 1969).

A simple model for a new instability resulting from particles trapped in a large-amplitude electrostatic wave is invoked to explain the generation of satellite frequencies in a recently reported experiment by Wharton, Malmberg, and O'Neil. The model predicts satellites on the large-amplitude wave at a frequency separation proportional to $\sqrt{E}$, where E is the amplitude of the large wave. The predicted growth rates reasonably account for the observed growth of these satellites. (auth)

51689 STABILIZATION OF A HOT ELECTRON PLASMA BY HOMOGENEOUS TEMPERATURE EFFECTS. Lisitano, G. (Institut fuer Plasma Physik, Garching, Ger.): DeDionigi, R.; Fontanesi, M. Phys. Rev. Lett., 23: 822-4(Oct. 13, 1969).

The suppression of drift instabilities in a magnetoplasma having high electron temperature is obtained by avoiding transverse temperature gradients. (auth)

51690 IMPROVEMENTS IN OR RELATING TO PLASMA STABILIZATION. (to Stichting voor Fundamenteel Onderzoek der Materie). British Patent 1,166,755. Oct. 8, 1969. Priority date July 7, 1966, Netherlands.

The plasma has a closed-ring configuration in a toroidal magnetic field. A cold gas blanket surrounds the plasma. The pressure of the gas blanket substantially compensates that of the

plasma and the gas blanket performs a rotary movement about the toroidal axis, i.e., the path formed by the axis of the curve as the curve is rotated to form the toroid, to inhibit growth of MHD instabilities resulting from any disturbance in the pressure compensation. (M.O.W.)

51691 SUPPRESSION AND ENHANCEMENT OF AN ION-SOUND INSTABILITY BY NONLINEAR RESONANCE EFFECTS IN A PLASMA. Keen, B. E.; Fletcher, W. H. W. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Phys. Rev. Lett., 23: 760-3(Oct. 6, 1969).

Results are presented which show the classical anharmonic resonance effects (including hysteresis) on a marginal ion–acoustic instability, when forcing at the fundamental and the subharmonic frequencies. Also, when the instability is well defined it appears to behave as a classical Van der Pol oscillator for drive frequencies near the fundamental and the subharmonics. (auth)

51692 MHD INSTABILITIES. Frieman, Edward A. (Princeton Univ., N. J.). pp 17-32 of Plasma Instabilities in Astrophysics. Wentzel, Donat G.; Tidman, Derek A. (eds.). New York, Gordon and Breach, Science Publishers, Inc., 1969.

From International Conference on Plasma Instabilities in Astrophysics, Pacific Grove, Calif. See CONF-681042.

The various kinds of MHD instabilities are briefly discussed: (1) Rayleigh–Taylor instability, (2) the interchange or flute mode, (3) general local stability criterion, (4) nonlocal MHD instabilities, (5) Kelvin–Helmholtz instability, and (6) FLR stabilization of MHD instabilities. (M.O.W.)

51693 TEARING MODE. Furth, H. P. (Princeton Univ., N. J.). pp 33-47 of Plasma Instabilities in Astrophysics. Wentzel, Donat G.; Tidman, Derek A. (eds.). New York, Gordon and Breach, Science Publishers, Inc., 1969.

From International Conference on Plasma Instabilities in Astrophysics, Pacific Grove, Calif. See CONF-681042.

A brief review is given of the basic mechanism of the tearing mode. Three problems of current interest are then discussed: (1) the question of the most unstable wavelength, (2) the energetics of the resistive and collisionless tearing modes, and (3) the stability of the tearing mode in 2-dimensional equilibria. (M.O.W.)

51694 TWO-STREAM INSTABILITIES. Simon, Albert (Univ. of Rochester, N. Y.). pp 49-58 of Plasma Instabilities in Astrophysics. Wentzel, Donat G.; Tidman, Derek A. (eds.). New York, Gordon and Breach, Science Publishers, Inc., 1969.

From International Conference on Plasma Instabilities in Astrophysics, Pacific Grove, Calif. See CONF-681042.

A uniform, infinite, collisionless plasma with a stream of electron passing through a medium composed of ions and electrons is theoretically studied. The Vlasov theory is used to analyze small electrostatic oscillations. (M.O.W.)

51695 VELOCITY-ANISOTROPY INSTABILITIES. Harris, E. G. (Univ. of Tennessee, Knoxville. Oak Ridge National Lab., Tenn.). pp 59-70 of Plasma Instabilities in Astrophysics. Wentzel, Donat G.; Tidman, Derek A. (eds.). New York, Gordon and Breach, Science Publishers, Inc., 1969.

From International Conference on Plasma Instabilities in Astrophysics, Pacific Grove, Calif. See CONF-681042.

Microinstabilities due to anisotropies of the velocity distributions of the ions and the electrons of the plasma are discussed. The quasi-static approximation was used in the analysis. (M.O.W.)

51696 CRITICAL FIELDS AND STRUCTURE OF ION–ACOUSTIC INSTABILITY OF THE PLASMA OF AN INDUCTION HIGH-FREQUENCY DISCHARGE IN H_2, Ar, AND Hg IN A MAGNETIC FIELD. Vdovin, V. L.; Rusanov, V. D.; Frank-Kamenetskii, D. A. JETP Lett. (USSR) (Engl. Transl.), 10: 76-9 (Aug. 5, 1969).

Translated from Zh. Eksp. Teor. Fiz. Pis'ma Redaktsiyu, 10: 120-5(Aug. 5, 1969).

Study of a weakly ionized hf discharge plasma has shown that, when the magnetic field reaches a critical value, the plasma becomes unstable both in an induction discharge and in an E discharge. Critical field and ion acoustic instability data are given for the gases H_2, He, Ar, and Hg. (M.O.W.)

51697 LINEAR STABILITY OF A PLASMA DIODE. Dobrowolny, M.; Engelmann, F.; Sestero, A. (EURATOM-CNEN, Rome). Z. Naturforsch., 24a: 1235-43(Aug. 1969).

The stability of a plasma diode with respect to longitudinal oscillations is investigated. If there are free particles emitted by the electrodes, the perturbations do not have the same dynamics as they would in an infinite plasma, contrary to the case where only particles trapped in the diode are present. This can be interpreted as due to a coupling of plane waves of different wavelengths, introduced by the boundary conditions at the electrodes. The occurrence of resonant-particle effects, on the other hand, is subjected to precisely the same conditions as in an infinite plasma. (auth)

51698 EXPERIMENTAL INVESTIGATIONS OF THE RAYLEIGH–TAYLOR INSTABILITY OF A ROTATING HYDROGEN ARC IN AN AXIAL MAGNETIC FIELD. Doebele, H. F. (Institut fuer Plasmaphysik, Munich). Z. Naturforsch., 24a: 1249-58(Aug. 1969). (In German).

A hydrogen arc with a hollow anode in an axial magnetic field is subjected to Rayleigh–Taylor instabilities as a result of rotation due to the radial current components at the anode. These instabilities take the form of periodic fluctuations in the light intensity emitted from the boundary regions of the arc. The modes m = 4 to m = 7 which occur in succession with increasing magnetic field are identified by measuring the signal phases in end-on observation of the arc. The rotational velocity of the arc plasma is determined spectroscopically and comparison is made with the nondissipative MHD theory, which yields growth rates $\sim\sqrt{m-1}$. The deviations from this theory that were observed in this experiment are ascribed to dissipative effects. (auth)

51699 ON A NEW TYPE OF PLASMA PARTIALLY IONIZED INSTABILITY. Akhiezer, A. I.; Akhiezer, I. A.; Angeleiko, V. V. (Kharkov State Univ.). Zh. Eksp. Teor. Fiz., 57: 870-6(July 1969). (In Russian).

The stability of a partially ionized plasma is investigated by taking into account ionization and recombination processes. Due to the processes in such a plasma, specific ionization–recombination oscillations may occur. It is shown that, in this case, an instability due to parametric excitation of ion–acoustic oscillations may arise, the ion–acoustic oscillations being characterized by the largest increment. The double frequency of the oscillations is close to the frequency of the ionization–recombination oscillations. (auth)

51700 STABILITY OF THE SCREW PINCH. Schuurman, W.; Bobeldijk, C.; De Vries, R. F. (FOM-Instituut voor Plasma-Fysica, Jutphaas, Netherlands). Plasma Phys., 11: 495-506 (June 1969).

A screw pinch, i.e., a finite β plasma column compressed by a helical magnetic field, has been found to be considerably more stable than follows from existing theories. The reason is that in experiments the magnetic field around the central plasma column carries a strong force-free current, whereas theory usually assumes a vacuum configuration. A normal-mode stability analysis is given of a cylindrical screw pinch with a uniform-pitch magnetic field in the pressureless plasma. According to this analysis the screw pinch is stable (even for the m = 1 mode) as long as β does not surpass a critical value β_c. (auth) (UK)

51701 FLUTE INSTABILITY IN A RAREFIED NONCOMPENSATED PLASMA. Dnestrovskii, Yu. N.; Kostomarov, D. P.; Chechina, A. A. (Moscow State Univ.). Zh. Tekh. Fiz., 38: 1205-13(Aug. 1968). (In Russian).

Numerical methods are used to investigate flute instability in a rarefied plasma with inherent electric field. The influence of the plasma-density profile and of the magnitude of the undercompensation on the plasma stability in a magnetic field with simple mirror geometry and in a field with minimum |H| is investigated. The obtained plasma-stability limits show that, even when the current in the stabilizing windings is large, an uncompensated plasma may turn out to be unstable as a result of the radially inhomogeneous electric drift of the electrons and of the ions. (ATD)

51702 PARAMETRIC AMPLIFICATION IN AN rf-SUSTAINED PLASMA CAPACITOR. Asmussen, Jes Jr.; Lee, Quong H. (Michigan State Univ., East Lansing). Appl. Phys. Lett., 15: 183-6(Sept. 15, 1969).

The experimental results of a radiation-induced instability in a completely rf-sustained plasma capacitor discharge are discussed. Nonlinear coupling between electron plasma modes and ion–acoustic modes was observed, resulting in a four-frequency parametric interaction. By reducing the microwave pump power below the power threshold required for the instability, the rf-pumped plasma capacitor is able to amplify a separately applied c-w input signal when this signal is in the vicinity of one of the parametric resonances. Experimental results are presented which show the effect of the capacitor size and input pump power on the parametric interaction. (auth)

51703 INFLUENCE OF PAIR SCATTERING ON THE STABILITY PLASMA–BEAM SYSTEMS. Gurin, A. A.; Kolesnichenko, Ya. I. Zh. Tekh. Fiz., 38: 2022-30(Dec. 1968). (In Russian).

A kinetic model describing collisions in nonequilibrium multicomponent plasma was studied. The model contained an auxiliary parameter (an effective collision frequency) which, in addition to determining the pair collisions between particles inside separate components, also determined intercomponent collisions. The

model was used for studying the influence of collisions on the oscillations in a plasma–beam system free of any magnetic field. Data obtained showed that the pair collisions at certain plasma parameter magnitudes significantly affect the beam instability conditions by stabilizing the short-wave section of the oscillation spectra. (R.V.J.)

Thermonuclear Processes

Refer also to abstracts 50207 and 50214.

51704 (CEA-CONF-1391) TROCHOIDAL E x B ANALYSER FOR HOT ELECTRON PLASMA. Kawasaki, S. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). [1969]. 3p. (CONF-690803-24). Dep. CFSTI (U. S. Sales Only).

From 9th International Conference on Phenomena in Ionized Gases, Bucharest, Romania.

An E × B electron analyzer used by Perkins and Barr, which is placed in a homogeneous axial magnetic field, is a convenient spectrometer for the measurements of hot electrons flowing out from an open-ended system. One variant of their analyzer is proposed here which is theoretically valid for electrons up to relativistic energies without ambiguity accompanied with the Larmor oscillation. These characteristics are obtained by the application of the focusing property of charged particles in E × B fields. An analyzer of this type was designed so as to measure the distribution functions of hot electrons (0.2 ~ 60 keV) escaping from a mirror-confined plasma. Its application to the Bille-en-Tête system is specified. (M.O.W.)

51705 (JPRS-46949, pp 43-5) MAGNETIC SURFACE DISTORTION IN THE STELLARATOR S-1. Karmanov, F. V.; Cheremnykh, P. A. Translated from Zh. Tekh. Fiz., 38: 1475-6(1968).

When studying the magnetic field of the S-1 stellarator it was discovered that the magnetic surfaces are appreciably distorted. The deformations are manifested in the form of blips running from the separatrix to the vacuum chamber wall. The deformations increase with an increase in the ratio of h_3/H_0. (auth)

51706 (JPRS-49025) PHYSICS OF HIGH-TEMPERATURE PLASMAS. Artsimovich, L. A. Translated from Priroda, No. 8, 2-13(1969). 24p. CFSTI (U. S. Sales Only).

The basics of controlled thermonuclear research and plasma physics are discussed. The Tokamak equipment and some experimental results are briefly described. (M.O.W.)

51707 (MATT-721) FERROMAGNETIC HELICAL STABILIZER. Sheffield, G. (Princeton Univ., N. J. Plasma Physics Lab.). Aug. 1969. Contract AT(30-1)-1238. 14p. Dep. CFSTI.

A ferromagnetic stabilizer is described which can be substituted for an electromagnetic stabilizing winding in axial fields up to 1.0 Tesla. The magnetic characteristics of the iron configuration are established by means of a computer simulation. The advantages of this stabilizer are that it requires no power supply and that it is inexpensive to construct. (auth)

51708 (NP-tr-1845) L-1 STELLARATOR. Berezhetski, M. S.; Grebenshchikov, S. E.; Sbitnikova, I. S.; Shpigel, I. S. (Akademiya Nauk SSSR, Moscow. Institut Fiziki). Translated for Culham Lab., Abingdon, Eng., from pp 1-9 of Preprint No. 57. 8p. (CTO-636). Dep. CFSTI (U. S. Sales Only).

A brief review of the main experiments carried out on the L-1 stellarator is given. The magnetic field structure, plasma injection, confinement, and electron cyclotron heating are described. (M.O.W.)

51709 (NP-tr-1846) TOR-1 STELLARATOR. Andryukhina, E. D.; Fedyanin, O. I.; Kholnov, Yu. V. (Akademiya Nauk SSSR, Moscow. Institut Fiziki). Translated for Culham Lab., Abingdon, Eng., from pp 9-12 of Preprint No. 57. 4p. (CTO-637). Dep. CFSTI (U. S. Sales Only).

Tor-1 is a closed magnetic trap with an n = 2 helical magnetic field and the following principal parameters: (1) parallel magnetic field H_0 = 20 kOe; (2) major torus diameter 120 cm; (3) diameter of vacuum vessel 10 cm; (4) magnetic field period T = 20 to 120 msec; and (5) maximum capacitor bank energy 2.12 MJ. (M.O.W.)

51710 (NP-tr-1847) TOR-2 STELLARATOR. Ivanovskii, M. A.; Popov, S. N.; Popryadukhin, A. P. (Akademiya Nauk SSSR, Moscow. Institut Fiziki). Translated for Culham Lab., Abingdon, Eng., from pp 13-18 of Preprint No. 57. 5p. (CTO-638). Dep. CFSTI (U. S. Sales Only).

The Tor-2 design provides for an l = 2 helical field in the confinement region; the number of field periods over the length of the torus can be varied from 0.5 to 13 or 14, and also the ratio $\epsilon = B_2/B_0$ of the amplitude of the helical B_2 harmonic to the parallel B_0 field. The design of Tor-2 is discussed in general. (M.O.W.)

51711 (NP-tr-1853) CONTROLLED FUSION ELECTRIC GENERATOR. de Montgremier, Augier. Translated for Culham Lab., Abingdon, Eng., from French Patent 1,599,596. 7p. (CTO-651). Dep. CFSTI (U. S. Sales Only).

The invention concerns a controlled fusion electrical generator and relates in particular to the problem of controlled fusion, thermonuclear reaction conditions being realized by the acceleration of charged particles in an electromagnetic field by means of an independent device of compact size; energy produced is converted into electrical energy for a considerable continuous power output in the 10-kW, 10-MW, and 10^4-MW ranges. (M.O.W.)

51712 (UCRL-71763) FUSION REACTION POWER CONVERSION STUDIES. Mohr, P. B. (California Univ., Livermore. Lawrence Radiation Lab.). Sept. 4, 1969. 26p. (CONF-690901-5). Dep. CFSTI.

From International Conference on Nuclear Fusion Reactors, Culham, England.

The recovery of thermal and charged-particle energy from thermonuclear reactions was studied in relation to the energy requirements of plasma confinement, maintenance, and replenishment. Increased conversion efficiency made possible by advances in technology is the principal means examined for offsetting these parasite power requirements. For each value of plasma maintenance power relative to reaction power, a set of conversion system parameters can be determined, which results in minimum net power cost. Since vapor pressures increase and material strengths decrease inexorably with temperature, this minimum increases unrelentingly with both plasma maintenance power fraction and conversion efficiency (temperature) for all systems investigated. Of the conventional thermodynamic systems, binary Rankine cycles appear to offer an attractive combination of efficiency and economics for early reactor designs with presumed moderate-to-high plasma energy losses. (auth)

51713 METHOD AND APPARATUS FOR PRODUCING NUCLEAR-FUSION REACTIONS. (to International Standard Electric Corp.). British Patent 1,165,550. Oct. 1, 1969. Priority date May 13, 1966, United States.

This invention uses self-generated electric fields for containing the ionized gases. An electric-discharge device with an anode which surrounds a cathode that electrically encloses a structureless space or volume is described. Specifics of anode and cathode structure are given. (M.O.W.)

51714 APPLICATION OF THE ENERGY PRINCIPLE TO ASTRON-TYPE AND OTHER AXISYMMETRIC DEVICES. Johnson, John L.; Kulsrud, Russell M.; Weimer, Katherine E. (Princeton Univ., N. J.). Plasma Phys., 11: 463-72(June 1969).

The stability of Astron-type devices is investigated on the basis of a model in which the electrons in the E layer are assumed rigid. It is shown that stability is given by the usual energy principle provided that the current density is replaced by the plasma current density. The theory of general axisymmetric systems of Bernstein et al., is extended to include this model, and the stability criterion is found to be given by a slightly modified second-order eigenvalue equation along the closed lines. An expression for the critical pressure for ballooning modes is found in the next order in an expansion in pressure. The differential equation is solved numerically for explicit Astron-type configurations. (auth) (UK)

51715 ELECTRICAL POTENTIAL DISTRIBUTION IN A COAXIAL QUASI-STATIONARY PLASMA INJECTOR. Kislov, A. Ya.; Morozov, A. I.; Tilinin, G. N. Zh. Tekh. Fiz., 38: 975-8(June 1968). (In Russian).

Oscillograms were constructed of electric potential distribution in a quasi-stationary plasma injector. Pulsed discharge currents of ~1.5-msec duration and of nearly rectangular shape were analyzed. The current in the experiments varied from 20 to 50 kA, and the voltage of the discharge varied from 150 to 350 V. Controlled amounts of nitrogen were supplied by means of a pulsed valve and other auxiliary devices. Before injection, the chamber was pumped to a pressure of $\sim 10^{-2}$ mm Hg. It was found that the probe indices did not depend on its construction (plane or cylindrical) or on its orientation with respect to the plasma jet. Typical oscillograms with various probes are presented. Equipotential curves in the injector are presented for two typical operations with different electrode polarities. (R.V.J.)

51716 CONTRIBUTION TO THE THEORY OF AN EROSION PLASMA SOURCE. Balyberdin, V. V.; Khizhnyak, N. A. (Kharkov Aviation Inst.). Zh. Tekh. Fiz., 38: 1556-62(Sept. 1968). (In Russian).

A theoretical investigation was made of the process of electrodynamic acceleration of plasmoids in a "rel'sotron" device, with allowance for the energy lost to the Joule heating of the plasma and the erosion of the electrodes. Account was also taken of the influence of the delay of the maximum of the mass release on the parameter of the accelerated plasmoid. The results of a numerical integration of the equations of the source have shown that although the velocity of the plasma increases with increasing delay time, the mass of the eroded substance captured in the acceleration process decreases. The absolute values of the mechanical momentum in this time increase and tend to saturation. The authors indicate that there exists an optimal length of plasma accelerator, at which the thrust coefficient of the energy conversion (the ratio of the energy of the directional motion to the energy stored in the capacitor bank) reaches a value which is maximal for the given conditions. It is therefore advantageous to choose a large delay time. One of the ways of increasing the indicated conversion coefficient is to increase the initial mass of the working body of the source, thus imposing definite requirements on the operation of the igniting spark. (ATD)

51717 PLASMA COMPRESSION ON THE TUMAN MACHINE. Afrosimov, V. V.; Berezin, A. B.; Golant, V. E.; (and others) (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekh. Fiz., 38: 1878-87(Nov. 1968). (In Russian).

Experiments on the adiabatic compression of plasma in a magnetic toroidal-type field were studied. Preliminary plasma heating was done by means of a toroidal discharge. Before compression the plasma concentration was 1.2×10^{14} cm^{-3} and the temperature was 6 to 10 eV. The compression was achieved by increase of the magnetic field from 0.5 to 10 kOe in 20 μsec. Optical measurements showed the plasma radius reduced 3 to 4 times during compression. Corpuscular measurements showed the plasma concentration inside the pinch increasing 5 to 7 times. Moreover, experiments on uhf-localized plasma near the diaphragm showed a significant reduction in the plasma concentration. (tr-auth)

Wave Phenomena

51718 (CEA-CONF-1389) LOW FREQUENCY DRIFT WAVES IN CYLINDRICAL GEOMETRY: EFFECT OF AN ELECTRIC FIELD AND IMPORTANCE OF THE DEBYE LENGTH. Luc, H. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). [1969]. 4p. (CONF-690803-25). Dep. CFSTI (U. S. Sales Only).

From 9th International Conference on Phenomena in Ionized Gases, Bucharest, Romania.

The linear dispersion relation is established for low-frequency quasi-electrostatic waves in a collisionless plasma with a density gradient, in a strong homogeneous magnetic field, and in cylindrical geometries. The effect of a solid-body rotation of the plasma column, in the case of a very small Debye length, is considered. The effect of a finite Debye length in the absence of an electric field is considered next. (M.O.W.)

51719 (CEA-CONF-1395) SPLITTING EFFECT OF ELECTRON CYCLOTRON HARMONIC WAVES INTO DOUBLE MODES DUE TO TRANSVERSE TEMPERATURE. Olivain, J.; Perceval, F.; Perulli, M. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). [1969]. 4p. (CONF-690803-27). Dep. CFSTI (U. S. Sales Only).

From 9th International Conference on Phenomena in Ionized Gases, Bucharest, Romania.

Frequency and wave number spectrum measurements were performed to analyze cyclotron harmonic waves in electron beams. In the case of two counterstreaming electron beams, these spectra exhibit a double peak structure which supports the theoretical prediction of cyclotron harmonic mode splitting due to the transverse temperature. (auth)

51720 (JPRS-46949, pp 33-42) SOUND WAVE EXCITATION IN A GAS BY CURRENT PULSES. Kozlov, Yu. G.; Shukhtin, A. M. Translated from Zh. Tekh. Fiz., 38: 1465-71(1968).

Data are given on the conductance of a gas-discharge plasma in the process of its decay during impulsive discharge in inert gases under average pressures (5 to 15 mm Hg). Longitudinal and radial sound vibrations excited by a current pulse in various stages of plasma decay were observed. The presence of many types of oscillations the frequency of which is related to the temperature, molecular weight of the gas and geometry of the discharge tube was noted. The study of free sound vibrations can turn out to be useful for purposes of low-temperature plasma diagnostics. (tr-auth)

51721 (MATT-673) ION CYCLOTRON WAVE GENERATION IN THE MODEL C STELLARATOR. Hosea, J. C.; Sinclair, R. M. (Princeton Univ., N. J. Plasma Physics Lab.). June 1969. Contract AT(30-1)-1238. 50p. Dep. CFSTI.

To permit quantitative comparisons between experiment and theory, ion cyclotron wave generation by the Stix coil system of the Model C stellarator is analyzed using a coil–plasma model that closely approximates the physical system: filamentary currents at the coil loop positions induce plasma waves that propagate along the "cold" plasma column, which is coaxial with a cylindrical waveguide. Most important in the analysis is the inclusion of finite electron inertia effects, which cause the natural modes of the system to be characterized by two radial wave numbers in place of one, and which can seriously modify the properties of the ion cyclotron waves. Coil-loading predictions are in good absolute agreement with experimental observations for wide ranges of plasma density and magnetic field, thus demonstrating the relevance of the "cold" theory to the laboratory plasma. However, magnetic field predictions are larger than the fields measured far from the Stix coil, suggesting wave attenuation by processes not contained in the theory. (auth)

51722 REFLECTION OF ELECTROMAGNETIC WAVES ON A PLASMA LAYER WITH THE EPSTEIN PROFILE OF ELECTRON DENSITY. Musil, J. (Inst. of Plasma Physics, Prague). Czech. J. Phys., B19: 1309-11(1969).

Because a layer of plasma with the Epstein profile of electron density N(z) has no discontinuities in the electron density gradient it can be successfully used for the study of very thin layers and may also be used in microwave diagnostics of the laboratory plasma. The thickness of layers of laboratory plasmas L is often of the order of the wavelength $L \gtrsim \lambda_0$. The results of the numerical calculation of the reflection of electromagnetic waves on such thin layers from formulas derived earlier are given. (M.O.W.)

51723 CYCLOTRON WAVE TRANSMISSION ACROSS A PLASMA. Lamborn, B. N. A. (Florida Atlantic Univ., Boca Raton). Phys. Rev. Lett., 23: 744-6(Oct. 6, 1969).

The relativistic Vlasov dispersion relation is used to find the critical density $n_c = 3B_M^2 kT/8\pi m^2 c^4$ below which the extraordinary wave can propagate freely across a mirror-field plasma into the cyclotron-resonance region. (auth)

51724 PROPAGATION OF ELECTROMAGNETIC WAVES IN QUANTIZED MAGNETIC FIELD IN THE CASE OF MONOAXIAL CRYSTAL WITH ELECTRON PLASMA. Gurevich, L. E.; Tarkhanyan, R. G. (Inst. of Physics and Tech., Leningrad). Fiz. Tekh. Poluprov., 3: 1139-47(Aug. 1969). (In Russian).

Propagation and reflection of electromagnetic waves in a monoaxial crystal with electron plasma in a quantizing magnetic field was studied considering the permeable and non-permeable regions. The spatial dispersion and additional waves were studied near the first and second cyclotron and plasma resonances. It was revealed that all three conditions (anisotropy, presence of quantizing magnetic field, and space dispersion) resulted in a series of new effects. (tr-auth)

51725 RESONANCE EXCITATION OF ION-CYCLOTRON OSCILLATIONS IN A ROTATING PLASMA. Rozhkov, A. M.; Sinel'nikov, K. N.; Suprunenko, V. A.; Farenik, V. I.; Vlasov, V. V. (Physical-Technical Inst., Moscow). JETP Lett. (USSR) (Engl. Transl.), 10: 46-8(July 20, 1969).

Translated from Zh. Eksp. Teor. Fiz. Pis'ma Redaktsiyu, 10: 71-5(July 20, 1969).

The collective interaction in a magnetron lens, in which the radial electric field and the longitudinal magnetic field cause the plasma to rotate at an angular frequency $\omega_{rot} \sim cE_r/aH_z$ (a = plasma radius), is studied. Resonance excitation of ion cyclotron instability was observed when the ion cyclotron frequency ω_{Hi} became equal to a multiple of the angular rotation frequency ($\omega_{Hi} \sim 2\omega_{rot}$). (M.O.W.)

51726 PARAMETRIC EXCITATION OF LONGITUDINAL OSCILLATIONS IN A PLASMA BY A WEAK HIGH FREQUENCY ELECTRIC FIELD. Andreev, N. E.; Kirii, A. Yu.; Silin, V. P. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz., 57: 1024-39(July 1969). (In Russian).

At frequencies of an external uhf field close to the electron Langmuir frequency, parametric instability of a plasma arises at comparatively small values of the external field strength. Expressions are derived for the plasma oscillation increments and frequencies. Relations between the amplitudes that define the phase shift of the high-frequency plasma waves relative to the phase of the external field are also obtained. The threshold values of the uhf field strength are determined in a broad range of parameters. Values of the perturbation wave vectors characteristic of the beginning of instability are also determined. (auth)

51727 NONLINEAR SUM AND DIFFERENCE FREQUENCY GENERATION IN AN INHOMOGENEOUS MAGNETOPLASMA.

Sodha, M. S.; Gupta, G. P. (Indian Inst. of Tech., New Delhi). Plasma Phys., 11: 473-94(June 1969).

An analytical study was made of the nonlinear generation of the sum and difference frequency components, in the current density in a magnetoplasma, due to two alternating electric fields, an electron density gradient, and a temperature gradient. The results of this study are used in investigating the nonlinear growth of sum and difference frequency waves in a magnetoplasma, when two electromagnetic waves of different frequencies are propagating along the same direction in it and, also, in evaluating the magnitude of these frequency components in the reflected wave from a magnetoplasma-free space interface when the two electromagnetic waves are normally incident on the interface. (auth) (UK)

51728 EXCITATION OF IONIC–ACOUSTIC WAVES IN NON-ISOTHERMAL PLASMA UNDER SKIN-EFFECT CONDITIONS. Kondratenko, A. N.; Onishchenko, I. N. (Kharkov Inst. of Physics and Tech.). Zh. Tekh. Fiz., 38: 1397-1400(Aug. 1968). (In Russian).

Studies were made of the excitation of ion–acoustic waves in plasma layers with oblique electromagnetic wave incidence in which the electric vector was distributed in the plane of incidence. The coefficients of reflection during the transmission and absorption of incident wave energy were obtained, and the shape of the longitudinal waves in the plasma was determined. (tr-auth)

51729 NONLINEAR INTERACTION BETWEEN SPACE AND SURFACE WAVES IN A BOUNDED PLASMA. Karplyuk, K. S.; Oraevskii, V. N. Zh. Tekh. Fiz., 38: 1214-16(Aug. 1968). (In Russian).

A procedure was developed for the construction of the theory of interaction of waves in a bounded plasma. For an effective construction of the matrix elements describing the wave interaction processes, it is proposed to use a system of equations that is conjugate to the initial system. The method is used to obtain the matrix elements with interaction of slow high-frequency waves propagating in a cylindrical plasma column. The analysis is carried out in the hydrodynamic approximation for the case of zero temperature of the plasma electrons. Certain features of the interaction of surface and volume waves are studied. (ATD)

51730 NOISE EMISSION AND LANDAU DAMPING OF TONKS–DATTNER RESONANCES. Prinzler, H. (Physikalisch-Technisches Inst., Berlin). Plasma Phys., 11: 507-18(June 1969).

Observations of plasma resonances have shown that the noise emission and impedance of the resonance peaks can be related by using network theory including Nyquist's formula. In the free-fall region of the discharge the noise temperature is considerably lower than the electron temperature. The collisionless part of the damping is due to Landau damping, enhanced by the radial inhomogeneity of the electron profile. (auth) (UK)

51731 INVESTIGATION OF STABILITY OF LONGITUDINAL SHORT-WAVE OSCILLATIONS IN THE QUASI-ONE-DIMENSIONAL FLOW OF CONDUCTING GAS. Artyushkov, E. V. (Inst. of Atomic Energy, Moscow). Teplofiz. Vys. Temp., 6: 851-62 (Sept.-Oct. 1968). (In Russian).

The order of possible instabilities in the flowing gas was studied. Most critical, from the instability point of view, is the area of strong heat release in the gas. The instabilities in question are stabilized by sufficiently high electric or thermal conductivity, or by the fast increase of radiation emission with temperature. With strong heat release and moderate thermal conductivity, oscillations can be stabilized because of the fast increase of radiations. In the case of moderate heat release, oscillations are stable in the absence of the anomalous radiations and with high thermal conductivity of the gas. Examples of development of perturbations along the flow are examined. (tr-auth)

51732 MICROWAVE TRANSMISSION THROUGH A PLASMA-FILLED WAVEGUIDE OF FINITE LENGTH, ABOVE THE CUT-OFF DENSITY. Raicu, Dan (Physics Inst., Bucharest). Int. J. Electron., 26: 391-8(Apr. 1969).

The phenomenon of microwave tunneling through a finite length waveguide filled by plasma in cutoff conditions is considered. The transmission coefficient of the plasma region is calculated and on this basis a method for the determination of the free-electron density of the plasma is derived. This method is applied in the case of a cold cathode discharge with a double plane geometry inside an x-band waveguide for the experimental study of the plasma density as a function of the discharge current. (auth) (UK)

51733 ANALYSIS OF NOISE SPECTRUM OF THE ABSORBED rf WAVE IN PLASMA IN THE REGION OF ANOMALOUS DISPERSION. Nandedkar, D. P.; Bhagavat, G. K. (Indian Inst. of Tech., Bombay). Int. J. Electron., 26: 345-67(Apr. 1969).

In previous papers (Bhagavat and Nandedkar, 1968 and 1969) investigations of the damped oscillations, rf energy transport, backward waves and absorption of a rf wave in a plasma in the region of anomalous dispersion were reported. In the present paper an analysis of the absorbed rf wave in the plasma in the region of anomalous dispersion is carried out. The absorbed rf wave exhibits itself as noise. The peak of the noise spectrum lies in the far-infrared region of the spectrum of electromagnetic waves. (auth) (UK)

51734 STUDY OF THE DISINTEGRATION OF A LANGMUIR WAVE. Laval, G.; Pellat, R.; Perulli, M. (EURATOM–CEA, Fontenay-aux-Roses, France). Plasma Phys., 11: 579-88(July 1969). (In French).

An electron plasma wave disintegration is studied experimentally and theoretically in a plasma confined by a strong magnetic field. (auth) (UK)

51735 HIGH-FREQUENCY ELECTROSTATIC INSTABILITIES PROPAGATING PURELY TRANSVERSE TO THE MAGNETIC FIELD. Brossier, P.; Girard, J. P.; Hennion, F. (EURATOM–CEA, Fontenay-aux-Roses, France). Plasma Phys., 11: 589-600 (July 1969). (In French).

High-frequency instabilities which propagate purely transverse to the magnetic field in a mirror confined plasma with and without a radial density gradient are studied. In the first part, the effect of the energy spread of the particle distribution on the critical density and growth rates of these instabilities is shown. In the second part, the effect of an addition of cold Maxwellian ions to the hot plasma, which has a loss cone distribution are studied. The results are different depending on the mean energy of the Maxwellian ions. The growth rates of these instabilities are calculated. (auth) (UK)

51736 NONLINEAR EFFECTS IN THE NONHOMOGENEOUS MAGNETOACTIVE PLASMA IN THE RANGE OF PLASMA RESONANCE. Demchenko, V. V.; Dolgopolov, V. V. (Kharkov State Univ.). Zh. Tekh. Fiz., 38: 1843-9(Nov. 1968). (In Russian).

It is shown that the weak perturbation of density produced by nonlinear interactions of high-frequency fields resulted in a strong variation of the electromagnetic field in the region of plasma resonance. Curves describing the dielectric penetrability tensor components as functions of the space coordinate near the plasma resonance point were obtained. In the case in which the angle between the plasma density gradient and the direction of magnetic field is equal to zero or $\pi/2$, these curves may differ quantitatively from the corresponding curves obtained for isotropic media. Moreover, in the case of isotropic media, ambiguous regions appear indicating the importance of considering the spatial dispersion of plasma in these areas. (R.V.J.)

51737 HIGH-AMPLITUDE WAVE PROPAGATION ALONG PLASMA LAYERS. Demchenko, V. V.; Dolgopolov, V. V. (Kharkov State Univ.). Zh. Tekh. Fiz., 38: 1850-5(Nov. 1968). (In Russian).

Electromagnetic-wave propagation along plasma layers was studied for the case in which the pressure due to the electromagnetic waves was considerably stronger than the gas-kinetic pressure in the plasma. Dispersion equations and expressions were obtained for the fields, considering the thickness of the layer and dielectric penetrability. In the approximation of large amplitudes, the dispersion equations did not depend on the amplitude of the wave and plasma temperature. The experiments also showed that nonsymmetric wave propagation, with dielectric penetrability and field of one plasma layer boundary different from the respective magnitudes of other plasma layer, was possible. Dispersion equations for such a case were also obtained. (tr-auth)

51738 KINETIC THEORY OF WAVE REFLECTION FROM MOVING PLASMA LAYERS. Kondratenko, A. N. (Physical-Technical Inst., Kharkov). Zh. Tekh. Fiz., 38: 1835-42(Nov. 1968). (In Russian).

The kinetic approximation was studied as a reflection of the p-polarized electromagnetic wave from the moving layer of semiconfined plasma. The free plasma was distributed in a strong magnetic field. Propagation of an electromagnetic wave through a moving thin plasma layer at normal incidence was also studied. Coefficients of the energy wave reflection, propagation, and absorption are obtained. (R.V.J.)

51739 SCATTERING OF ELECTROMAGNETIC WAVES BY A MOVING CYLINDER WITH COATING PLASMA. Kojima, Toshitaka; Itakura, Kiyoyasu (Osaka Univ.). Electron. Commun. Jap. (Engl. Transl.), 51: 77-8(Oct. 1968).

The scattering of plane waves by a moving infinitely long metallic cylinder coated with uniform plasma was studied. The results of numerical calculations of angular distributions of the

scattered radiation are illustrated. The scattered radiation is concentrated in the direction of motion. This is a phenomenon of relativity theory which is also observed in radiation by a moving source. If the radius of the center conductor is very small compared to the radius of the plasma cylinder, then a further concentration of the forward scattered radiation can be seen with the increase of β, where β = velocity/c. This phenomenon is not observed in the case of the dielectric cylinder. The discussion is only for the case where the incident wave is the transverse magnetic wave, but a similar method can be applied for the transverse electric wave. (BBB)

51740 REFLECTION OF ELECTROMAGNETIC WAVES FROM THE BOUNDARY OF A SEMI-INFINITE PLASMA. Ohkubo, Matoaki (Gunma Univ., Kiryu, Japan). Electron. Commun. Jap. (Engl. Transl.), 51: 78-81(Nov. 1968).

An analysis was made of the reflection and transmission characteristics of the transverse magnetic component of the complex wave in a plasma resulting from the application of a static magnetic field parallel to the boundary between a semi-infinite plasma and air. The configuration is analyzed for such characteristics as surface impedance, power reflection coefficient, and power transmission coefficient. At a certain angle of incidence, there is generally a sudden increase in the reflection coefficient. There are two types of surface impedance, two kinds of reflection coefficient, and two kinds of transmission coefficient. With a reversal in magnetic field direction, irreversibility of sign in half of the system parameters (surface impedances, magnetic field reflection coefficients, and transmission coefficients) is found. Reversal of the magnetic field will cause an inductive impedance Z_2 to become capacitive. The power reflection coefficient and power transmission coefficient are not irreversibie. (BBB)

51741 EXPERIMENTAL INVESTIGATION OF NONLINEAR INTERACTIONS OF DRIFT WAVES. Hosken, Robert William. Urbana, Ill., Univ. of Illinois, 1968. 83p.

Thesis.

Collisionless cesium and potassium plasmas are investigated in a single-ended Q machine. A wave associated with the circular plasma-limiting aperture is observed when the plate temperature is high enough. This wave and the ordinary drift wave interact nonlinearly to produce new waves at the sum and difference frequencies. The amplitude of the wave at the difference frequency is an order of magnitude smaller than that of the primary waves which have the same order of magnitude amplitude. The background continuum is investigated and is seen to fall off as $\omega^{-\frac{1}{2}}$. (Diss. Abstr.)

51742 COLLISIONAL DAMPING OF PLASMA OSCILLATIONS. Wood, W. P.; Ninham, B. W. (New South Wales Univ., Kensington). Aust. J. Phys., 22: 453-8(Aug. 1969).

The attenuation of longitudinal electron oscillations in a dilute plasma is evaluated from the Krook approximation to the Boltzmann equation. The predictions of this model are compared with those of various other collision models. In the limit of "few collisions" there is complete qualitative agreement. However, the quantitative agreement among contributions beyond those due to dynamical friction is poor. (Australia)

Shielding

Refer also to abstracts 50012, 50199, 52049, and 52069–52071.

51743 (AD-689516) CONSTRIP V: A COMPUTER PROGRAM FOR THE VERTICAL BARRIER-FINITE-SOURCE PLANE GAMMA-RAY PENETRATION PROBLEM. PART I. Final Report, May 9, 1967–May 30, 1969. Doggett, Wesley O.; Bryan, Fred A. Jr. (Research Triangle Inst., Durham, N. C. Operations Research and Economics Div.). Apr. 1969. Contract N00228-67-C-2297. 435p. (RTI-R-OU-333-1; USNRDL-TRC-68-55). CFSTI.

The CONSTRIP V Computer Program is described. The primary purpose of the program is to investigate the variation of the direct and wall-scattered dose rate from an adjacent wall for various source geometries. In order to compute the protection factor for actual buildings, account must be taken of the effects of interior partitions, roof contribution, skyshine, and radiation from upper and lower floors by other computational methods. The program calculates the penetration of radiation from a uniformly contaminated horizontal source area through a shielding wall to a point detector. This program differs from its predecessors in three major aspects: (1) barrier shielding walls may have lower edges above the source plane, (2) the wall may be of arbitrary thickness, and (3) contributions may be calculated for irregularly shaped source fields which have mutually shielding structures superimposed on them such as occur at typical street intersections. Additionally, the calculations may be performed for photons of arbitrary source energy subject only to replacing the buildup factor currently supplied in the program for cobalt-60 with the appropriate buildup factor. (auth)

51744 (AD-689520) COMPARISON OF SCATTERED PORTION OF GAMMA RADIATION PENETRATING RIBBED AND PLANE SLABS. Report on Nuclear Radiation Shielding Studies. Thayer, G. R.; Dubois, G.; Roussin, R. W.; Chilton, A. B. (Illinois Univ., Urbana). May 1969. Contract N00228-66-C-0311. 125p. (NRSS-10; USNRDL-TRC-69-9). CFSTI.

On the basis of a correlated Monte Carlo technique, a computer program was developed that permits the comparison of the scattered portion of penetrating gamma radiation for ribbed slabs and for the corresponding smeared-out plane slabs. Four source configurations are studied: normally incident, broad, parallel beam; broad, parallel beam incident 60° to the normal; plane isotropic source; and a fan source. The photon energy assumed is 1.25 MeV. Several thousand cases are analyzed, involving a wide variation of geometric parameters. The resulting data are approximated by an empirical formula, and values for the formula parameters are provided. (auth) (USGRDR)

51745 (ORNL-tr-1891) MULTIPLE SCATTERING OF γ RADIATION IN MEDIA OF LOW ATOMIC NUMBER. Schaarschmidt, A. (Frankfurt Univ. (West Germany). Institut fuer Angewandte Physik). Translated for Oak Ridge National Lab., Tenn., from report BMwF-FBK-67-09. 84p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 21: 23234. (auth)

51746 (ORNL-tr-2214) DIRECT DETERMINATION OF TRANSMISSION AND REFLECTION MATRIXES FOR GAMMA RAYS. Maute, A. H. (Studiengesellschaft zur Foerderung der Kernenergieverwertung in Schiffbau und Schiffahrt e. V., Hamburg (West Germany)). Translated for Oak Ridge National Lab., Tenn., from German Report 11. 37p. Dep. CFSTI.

Transmission and reflection matrices of plane layers are calculated for γ-rays with the MOTRA 1-4 programs on the TR 4 computer. Comparisons were made with the double-P_1 transport program GAMP 3 on the ER 56. First the principles of the theory are considered. Then, the computer programs used are described. Finally, a report is given on the numerical results which are based on calculations with a suitably selected standard example. (M.H.R.)

51747 (ORNL-tr-3028) FAST NEUTRON SHIELDING BY ORDINARY CONCRETE. Sauermann, P. F.; Schaefer, W. Translated for Oak Ridge National Lab., Tenn., from Atompraxis, 14: 2p.(1968). 6p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 22: 49369. (auth)

51748 SHIELDING EFFECT OF PARAFFIN, WATER, SOIL, CONCRETE, IRON, AND LEAD FOR HIGH-ENERGY NEUTRONS. Saji, Yoshio; Ishihara, Toyokuki (Tokyo Univ.). Genshikaku Kenkyu, 14: No. 1, 1-12(July 1969). (In Japanese).

In order to survey the shielding effects of various substances for neutrons, experiments were carried out using neutrons produced from thick copper targets bombarded by 50-MeV protons. As detectors several BF_3 counters with paraffin moderators of various thicknesses were used. Dose attenuation lengths of 13.5 cm for paraffin, 13.0 cm for water, 14.6 cm for soil, 11.6 cm for ordinary concrete, 6.0 cm for iron and 7.2 cm for lead, respectively, were obtained. (NSA of Japan)

51749 ENERGY SPECTRA OF GAMMA RADIATION BEHIND TWO-LAYER BARRIER. Kol'chuzhkin, A. M.; Uchaikin, V. V.; Ryzhov, V. V.; Starukhin, V. V. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz., No. 12, 129-30 (1968). (In Russian).

Distribution of amplitudes was measured by means of a 20 × 20 mm scintillation crystal CsI(Tl) and an AI analyzer. Formulas were obtained for plane-parallel geometry and for a directional ^{137}Cs source. In accordance with the previous suggestion by Yutaka Furuta et al. (Nucl. Sci. Eng., 25: 85 (1966)) the source of ^{137}Cs (E_β = 0.661 MeV) was placed at a distance of 5 m from the absorption plate of 70 × 70 cm, and the distribution of pulse amplitudes N(H,q) was measured for the two-layer iron and aluminum barrier at two incident angles of 0 and 45°. Results are presented graphically. (R.V.J.)

51750 PERTURBATION METHOD FOR CALCULATING γ-RADIATION REFLECTION FROM TWO-LAYER SHIELDING. Kol'chuzhkin, A. M.; Uchaikin, V. V. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz., No. 12, 127-9(1968). (In Russian).

A perturbation method was used for determining the reflection from a two-layer barrier, in the case in which the thickness of the first layer is sufficiently thin. Formulas were developed for

calculating the albedo at source energies from 0.66 to 1.25 MeV. The main layer was a semi-infinite aluminum scatterer. The energy spectra for reflection from aluminum, calculated using the Monte Carlo method (8000 events), are shown in graphical form. The albedos for Pb + Al and Fe + Al barriers as a function of the first layer are also given. The most pronounced difference was found in Fe + Al combination in which a strong influence of Fe on the two-barrier albedo was observed. (R.V.J.)

Solid-State Physics

Radiation Effects

51751 EPR STUDY OF THE HOLE CENTERS IN PHENACITE. Lozykowski, H.; Wilson, R. G.; Holuj, F. (Univ. of Windsor, Ont.). J. Chem. Phys., 51: 2309-15(Sept. 15, 1969).

The centers created by x and uv irradiation of the single crystals of phenacite (Be_2SiO_4) at room temperature were studied by the EPR method. Well-documented proofs were offered that the centers involved $\cdot SiO_4^{3-}$ and $\cdot PO_4^{2-}$ radicals. The components of the g factor of the $\cdot SiO_4^{3-}$ radical are presented. They fit this model well. Also supporting this model are the hfs splittings which were attributed to two Be atoms. The components of the g factor and the hfs tensors of the $\cdot PO_4^{2-}$ radical were measured. The hfs tensor fits this description of the center well. (auth)

51752 LUMINESCENCE IN PHENACITE. Lozykowski, H.; Holuj, F. (Univ. of Windsor, Ont.). J. Chem. Phys., 51: 2315-21(Sept. 15, 1969).

Luminescent behavior and optical absorption of phenacite $BeSiO_4$ are compared with the results obtained for x- or uv-irradiated naturally occurring and synthetic phenacite crystals using the EPR method. It is thought that these crystals contain $\cdot PO_4^{2-}$ and $\cdot SiO_4^{3-}$ radicals, and the results indicate that they both act as luminescence centers. Emission bands, which might be assigned to both, have been identified. Thermoluminescence, thermoconductivity, and uv re-excitation were also investigated and compared to EPR results. (auth)

51753 POLARIZATION OF CHANNELED PARTICLES. Kaminsky, M. (Argonne National Lab., Ill.). Phys. Rev. Lett., 23: 819-22(Oct. 13, 1969).

A method of polarizing channeled deuterons by their passage through a monocrystalline nickel foil magnetized to saturation and subsequently through a region of weak magnetic field is described. A beam with tensor polarization $P_{zz} = -0.32 \pm 0.010$ is obtained. (auth)

51754 STUDIES OF RADIATION DEFECTS IN GERMANIUM IRRADIATED BY HIGH-ENERGY PROTONS. Konopleva, R. F.; Novikov, S. R.; Rubinova, E. E.; Zaporozhchenko, Yu. A.; Pokrovskii, V. N.; Nikityuk, L. N. (Inst. of Physics and Tech., Leningrad). Fiz. Tekh. Poluprov., 3: 1119-23(Aug. 1969). (In Russian).

The effects of 660-MeV protons on the electric and photoelectric properties of Ge were studied using n-type Ge with initial Sb concentration of 2×10^{15} cm^{-3} and p-type Ge with initial Ga concentration of 4×10^{14} cm^{-3}. Irradiation by the 660-MeV protons was carried out in a synchrocyclotron at integral fluxes from 10^{11} to 10^{14} r/cm^2. The reaction $^{27}Al(p,3pn)^{24}Na$ was used for measuring the doses. (R.V.J.)

51755 SECOND OPTIMUM TEMPERATURE FOR RADIATIVE BUILDUP OF F_1 CENTERS. Terent'ev, N. L.; Vaisburd, D. I. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz., No. 12, 112-15(1968). (In Russian).

Temperature dependence of the F_1 center buildup rate in RbCl, KCl, NaCl, and LiF crystals exposed to 1- to 7-MeV protons was studied in a temperature range from 78 to ~380°K. The optimum temperatures for radiative F_1 center buildup were: for KCl ≈ 240°K and for RbCl ≈ 220°K; two optimum temperatures were found for LiF at ≈ 250 and 350°K and for NaCl at ≈ 270 and 330°K. (R.V.J.)

51756 SHORT-TERM ANNEALING IN 14-MeV NEUTRON-IRRADIATED SILICON. Srour, J. R.; Curtis, O. L. Jr. (Northrop Corporate Labs., Hawthorne, Calif.). J. Appl. Phys., 40: 4082-6(Sept. 1969).

Using pulsed sources of 14-MeV neutrons (dose ~10^9 neutrons/cm^2) and fission neutrons, an investigation of short-term annealing in silicon has been performed. In n-type material, for approximately equal amounts of stable damage, the amount of unstable damage at 5×10^{-2} sec was ~3.0 times greater for 14 MeV than for fission-neutron irradiation. Considering that the ratio of stable damage for equal neutron fluences is ~2.8, the total and unstable damage ratios at this same time, for equal neutron fluences, are ~4.6 and ~8.5. Although the available dose of 14-MeV neutrons was small, it produced about a factor-of-two change in the carrier lifetime of high quality bulk material. No differences in the annealing curves were observed for fission-neutron irradiations varying by two orders-of-magnitude in dose, suggesting that the data obtained for 14-MeV neutrons would also be valid at higher doses. (auth)

51757 SPECTRA OF BOUND EXCITONS AND RADIATION DEFECTS IN COMPOUNDS A_2B_6. Lider, K. F.; Novikov, B. V.; Permogorov, S. A.; Razbirin, B. S. Zh. Prikl. Spektrosk., 10: 984-91(June 1969). (In Russian).

The appearance and intensification or weakening of the narrow emission lines of bound excitons in crystals of CdS, CdSe, and CdTe as a result of ion and deuteron bombardment were studied. Observed changes were connected with the appearance of radiation defects (metalloid vacancy type) in concentrations up to 3×10^{17} cm^{-3}. The annealing of radiation defects was studied. The broadening of the emission lines of free excitons in irradiated crystals is connected with the Franz–Keldysh effect in the field of charged radiation defects. (tr-auth)

51758 EVIDENCE FOR DISCOVERY OF CHEMICALLY BOUND NEUTRONS. Grant, T. J.; Cobble, J. W. (Purdue Univ., Lafayette, Ind.). Phys. Rev. Lett., 23: 741-4(Oct. 6, 1969).

Evidence was obtained that neutrons form a weak bond with electrons trapped in LiF at 4°K. The chemistry of the resulting n^- species was studied and shows that it decomposes at this temperature with a half-time in LiF of ~30 sec. The bond energy is probably about 0.1 eV. Removal of the trapped electrons greatly reduces, if not completely destroys, the neutron retention in LiF. (auth)

51759 ENERGY DEPENDENCE OF LATTICE DISORDER IN ION-IMPLANTED SILICON. Marsden, D. A.; Bellavance, G. R.; Davies, J. A.; Martini, M.; Sigmund, P. (Atomic Energy of Canada, Ltd., Chalk River, Ont.). Phys. Status Solidi, 35: 269-75(Sept. 1, 1969).

The energy dependence of lattice disorder was studied by implanting bismuth ions of energy 20 to 225 keV into silicon crystals at room temperature. Implant doses were kept below 6×10^{13} ions cm^{-2} to avoid approaching "saturation" disorder. Lattice disorder was measured by means of the orientation dependence of the backscattered yield of a 1.0-MeV helium ion beam (i.e., by the "channeling" technique). Within the experimental precision, the observed disorder increases linearly with implantation energy over the whole range studied. This linear dependence is consistent with the Kinchin–Pease equation, but its slope is at least a factor of two greater than the predicted value. Possible explanations for this discrepancy are discussed. The most reasonable one is that the disorder measured by the channeling technique includes not only the atoms that have been ejected into interstitial positions by the implantation, but also some of the lattice distortion resulting from this primary damage. (auth)

51760 SOME OPTICAL PROPERTIES OF BORON. Bachan, Z.; Gorazdowski, T.; Kolodziejczak, J. (Inst. of Physics, Warsaw). Phys. Status Solidi, 35: K37-8(Sept. 1, 1969).

The optical activity of β-rhombohedral boron was studied by measuring polarization effects (ellipticity and rotation of polarization plane) at 0.7 to 1.57 eV. The measurements were made for two polarizations with the electric vector parallel and perpendicular to the rod axis. The ellipticity, but not the rotation, is different for the two polarizations; the difference is maximum at 1.5 eV, where the extreme values also fall. (D.L.C.)

51761 BEHAVIOR OF INTERSTITIALS PRODUCED BY IONIZING RADIATION IN ALKALI METAL HALIDES. Sonder, E. (Oak Ridge National Lab., Tenn.). Phys. Status Solidi, 35: 523-34(Sept. 1, 1969).

The reactions occurring among radiation-produced defects after the primary production step are studied. For KCl, at liquid nitrogen temperature, the interstitial members of the radiation-produced Frenkel defects are known to be mobile. A model that has been mentioned repeatedly in the literature is compared with experimental data. In the model, rate equations are used to describe radiation-produced mobile interstitials which can either recombine with vacancies or can be trapped at other defect sites, causing the corresponding vacancies (F centers) to be stabilized. Asymptotic forms and analog computer solutions of simple forms of the equations are obtained. The experimental results include F-center growth curves which are approximately linear with irradiation dose and which demonstrate that for a wide range of radiation intensities the F-center production rate is proportional

to the dose rate. The predictions of the model are in accord with experimental results only for a rather extreme asymptotic case, for which a different description, which does not require the solution of rate equations, may be equally valid. (auth)

51762 INTERACTION OF POINT DEFECTS WITH FOREIGN ATOMS IN DILUTE Al–Mg ALLOYS IRRADIATED WITH NEUTRONS AT 78°K. Dimitrov, C.; Dimitrov, O. (Centre d'Etudes de Chimie Metallurgique, Vitry-sur-Seine, France). Phys. Status Solidi, 34: 545-57(Aug. 1, 1969). (In French).

The recovery of the electrical resistivity of a series of aluminum–magnesium alloys ($\leq 0.3 \times 10^{-6}$ to 3200×10^{-6} atomic) was studied after neutron irradiation at 78°K to doses of a few 10^{17} n/cm^2. The presence of magnesium produces a considerable increase of stage-II recovery, up to a constant value that is reached for concentrations higher than 1000×10^{-6}. Stage III increases slowly without reaching a constant value, even for the highest concentrations. A small stage III′ appears just above stage III. Magnesium additions do not change the activation energy measured in stage III: (0.59 ± 0.02) eV. The results are interpreted in terms of a model of interstitial trapping by impurities at 78°K and detrapping in stage II. On the basis of this model, the following values can be deduced from the experiments: interstitial–magnesium binding energy $E_{I\text{-}Mg} = (0.29 \pm 0.03)$ eV; vacancy–magnesium binding energy $E_{V\text{-}Mg} = (0.15 \pm 0.09)$ eV. (auth)

51763 PARAMAGNETIC RESONANCE OF THE $^2S_{1/2}$ STATE OF Cd^+ IONS IN NaCl CRYSTALS. Zhitnikov, R. A.; Melnikov, N. I.; Baranov, P. G. (Ioffe Inst. of Physics and Tech., Leningrad). Phys. Status Solidi, 35: K81-4(Sept. 1, 1969).

Cd^+ ions were obtained in NaCl: Cd^{2+} crystals by x irradiation and the paramagnetic (PR) spectra measured at 3 cm and 8 mm. The PR spectra of $^{111}Cd^+$ ions were measured at 77°K before and after warming to 300°K. Two groups of lines are symmetrical with respect to g = 2 and belong to $^{111}Cd^+$; the middle structure is due to Cl_2^- centers. The hyperfine and superhyperfine structure constants and g_I factors are listed for $^{111}Cd^+$ ions in NaCl at 77°K. (D.L.C.)

51764 LINEAR STARK EFFECT OF THE R CENTER IN LiF. Johannson, G. (Technische Hochschule, Darmstadt, Ger.). Z. Phys., 228: 222-34(1969). (In German).

A linear Stark effect on the R center is observed by studying the R_2 zero-phonon line in x-irradiated LiF crystals in high electric fields. A detailed description of the experimental equipment is given. The Stark effect is investigated under various conditions of field direction, field strength, and temperature. The changes of the R_2 zero-phonon line, caused by the electric field, are analysed by means of the method of moments. The results are consistent with the theory for E → A transitions in a center with C_{3v}-symmetry. By cooling the samples from 4.2 to 1.7°K, the zero-field splitting of the R center ground state was found to be <2 cm^{-1}. (auth)

51765 ANALYSIS OF SUBMONOLAYERS ON SILVER BY NEGATIVE SECONDARY ION EMISSION. Benninghoven, A. (Univ., Cologne). Phys. Status Solidi, 34: K169-71(Aug. 1, 1969).

Some of the advantages of using low current densities of primary ions to analyze the first monolayer on a solid surface by secondary ion emission and mass spectrometry, are described. Results from 3-keV argon-ion bombardment of Ag surfaces are presented. The secondary ions included Cl^-, NO_2^-, SCN^-, NO_3^-, SO_3^-, SO_4^-, and Ag^-. (D.L.C.)

51766 INFLUENCE OF GAMMA IRRADIATION ON PARAMETERS AND STRUCTURE OF SILICON p–n JUNCTIONS. Sirota, N. N.; Korshunov, F. P. (Physical Inst. of Solids and Semiconductors, Minsk). Fiz. Tekh. Poluprov., 2: 1671-7(Nov. 1968). (In Russian).

The influence of ^{60}Co gamma radiation on volt–ampere characteristics, barrier capacitance, and the effective lifetime of minority carrier diffusion in p–n junctions in silicon with specific resistances of 2, 10, and 250 ohm-cm was studied. It was found that, during irradiation, changes occur in the basic field and in the p–n junction zone, the conductivity of the diodes decreases linearly, barrier capacitance is decreased, effective lifetime of the minority carriers is increased, and the p–n junction is extended. The noted changes are irreversible, and the effect is greater the higher the specific resistance of silicon. (tr-auth)

51767 LOW-TEMPERATURE IRRADIATION AND ANNEALING OF P-TYPE GERMANIUM. Stas, V. F.; Smirnov, L. S. (Inst. of Physics of Semiconductors, Novosibirsk, USSR). Fiz. Tekh. Poluprov., 2: 1369-71(Sept. 1968). (In Russian).

The annealing of p-type germanium irradiated by 3.5-MeV electrons at liquid nitrogen temperature was studied. Germanium–gallium alloys with specific resistance ~5Ω cm and with density of dislocations 2 to 3×10^3/cm^2 was used. Measurements were made of the current-carrier concentration and specific electric conductivity. (tr-auth)

51768 EFFECTS OF Li ON THE RECOMBINATION RATE IN Si IRRADIATED BY FAST ELECTRONS. Kryukova, I. V.; Vavilov, V. S. (Moscow State Univ.). Fiz. Tekh. Poluprov., 2: 1312-17(Sept. 1968). (In Russian).

By means of measurements of short-circuit current that emerges in crystals with p–n junctions on irradiation by 1-MeV electrons, the effects of admixtures of lithium on the character and rate of decrease of the lifetime in different types of silicon were investigated. High-resistance zone-purified silicon with different concentrations of oxygen showed that the presence of lithium effectively promotes not only reduction of the rate of decrease of the lifetime during irradiation, but also reduced this parameter to the initial value after cessation of radiation. With an increase of lithium, the effect is more noticeable. An explanation of the observed effects is offered. (tr-auth)

51769 EFFECTS OF COPPER ADMIXTURE AND DISLOCATIONS ON FORMATION OF RADIATION DEFECTS IN GERMANIUM AND SILICON ON IRRADIATION BY FAST NEUTRONS. Konopleva, R. F.; Novikov, S. R. (Ioffe Inst. of Physics and Tech., Leningrad). Fiz. Tekh. Poluprov., 2: 1290-6(Sept. 1968). (In Russian).

The effects of a copper admixture and different-density dislocations on the rate of introduction of defects and on the level spectrum that appeared in the forbidden zone of germanium and silicon on irradiation by reactor neutrons was studied. Upon additional alloying by Cu in Ge increased defects are observed, while in silicon no noticeable change in defects occurred. The level spectrum showed that while in Ge with copper admixture, levels are observed that belong to Cu, in Si this did not show up. The introduction of a greater density of dislocations in Ge does not cause noticeable defect changes, while in Si defect decreases occur on the order of two. These different observations for Ge and Si are explained by the different character of radiation defects in these materials. (tr-auth)

51770 RATE OF INTRODUCTION OF GAMMA-RADIATION DEFECTS IN SILICON. Vinetskii, V. L.; Eritsyan, G. N.; Konozenko, I. D.; Starchik, M. I. (Inst. of Physics, Kiev). Fiz. Tekh. Poluprov., 2: 1236-42(Sept. 1968). (In Russian).

The rates of accumulation of gamma-ray defects in n- and p-type silicon were determined. In samples of n-type at doses ranging up to 10^8 quanta/cm^2, the average number of free vacancies, created per quantum λ_V, is constant in time. The values of λ_V and the ratio of probabilities of vacancy capture by an atom of oxygen and by an atom of phosphorus were found. In p-type samples the quantity λ_V decreases with time. The dependence of λ_V on the concentration of nonequilibrium free electrons possibly explains the above. This relation results either from the fact that the electron capture by initially formed weakly separated Frenkel pairs leads to their decomposition, or by the increase of the rate of diffusion of the free vacancies. (tr-auth)

51771 ENERGY AND ANGULAR DISTRIBUTIONS OF PROTONS CHANNELED THROUGH SINGLE CRYSTALS OF GERMANIUM AND SILICON ACCORDING TO (110) AND [110] CRYSTAL LATTICES. Shipatov, E. T. (Tomsk Polytechnic Inst., USSR). Fiz. Tekh. Poluprov., 2: 1690-1(Nov. 1968). (In Russian).

Protons channeled along lattices experience specific losses of energy that permit, according to measurement of the energy distributions, a study of the main rules of the channeling effect. Energy spectra of protons with initial energy 6.72 MeV measured at different angles of incidence relative to the direction of the {110} planes of 77-μ Ge single crystals are shown. (tr-auth)

51772 DEFECTS INTRODUCED IN N-TYPE GaAs ON IRRADIATION BY ^{60}Co γ QUANTA. Brailovskii, E. Yu.; Konozenko, I. D. (Inst. of Physics, Kiev). Fiz. Tekh. Poluprov., 2: 1620-2 (Nov. 1968). (In Russian).

The influence of ^{60}Co γ irradiation on the temperature dependence of σ and R_x of monocrystals of n-type unalloyed GaAs and monocrystals alloyed with Te, during the annealing of defects was studied. The irradiation produced defects of acceptor type with level $E_c - 0.16$ eV. The rate of introduction of these defects was 0.7 to 1.0×10^{-2} kV^{-2} cm^{-1} at integral doses up to 2.8×10^{18} γ/cm^2 and does not depend on the intensity within the limits 300 to 2100 R/sec. Conclusions are reached concerning inactive Te atoms in the formation of radiation defects, which determine change of concentration of current carriers at room temperature in n-type GaAs. (tr-auth)

51773 SPATIAL DISTRIBUTION OF RADIATION DEFECTS IN MATERIALS IRRADIATED BY BEAMS OF MONOENERGETIC PARTICLES. Bulgakov, Yu. V.; Kumakhov, M. A. Fiz. Tekh. Poluprov., 2: 1603-7(Nov. 1968). (In Russian).

An analysis was made of factors that have an effect on the nature of distribution of radiation defects in material (silicon, in this case) irradiated by the monoenergetic beams of protons and alpha particles with energies of several MeV. A relation was established between the position of maximum on the distribution curves and average path length of particles by straggling calculation, the multiple scattering of particles, and the migrations of the initial radiation effects. It is shown that according to the position of the maximum, it is possible to determine the energy of the particle with accuracy up to 0.1 to 0.2%. (tr-auth)

51774 PROTON RADIATION EFFECTS ON KINETICS OF MICROHARDNESS VARIATIONS IN CaF_2 CRYSTALS. Zavadovskaya, E. K.; Lisitsyna, L. A.; Ovcharov, A. T.; Lisitsyn, V. M. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz., No. 11, 132-3(1967). (In Russian).

Effects of 4.5-MeV proton irradiation on the microhardness of various CaF_2 crystals were studied. Control measurements revealed identical dislocation densities in irradiated and intact specimens. Kinetics of microhardness variations as a function of radiation dose were studied with natural and synthesized crystals. The results showed that the microhardness increased; however, the rate of growth of absorption curves was reduced. Maximum microhardness obtained for natural and synthesized CaF_2 crystals was 36 and 28%, respectively. The curves of four absorption bands (225, 335, 400, and 570 mμ) are analyzed. (R.V.J.)

51775 ION IMPLANTATION: A NEW METHOD OF DOPING SEMICONDUCTORS. [PART] II. Large, L. N. (Services Electronics Research Labs., Baldock, Eng.). Contemp. Phys., 10: 505-32(Sept. 1969).

A novel method for doping semiconductors is ion implantation, where impurities are injected in the form of high-energy ions. The range of these ions is well defined and is a function of ion energy and mass, the nature of the crystal, and its orientation to the beam. Some of the interesting techniques used to study the properties of implanted layers are described. In particular, the location of dopant atoms in the crystal and the disorder of the lattice after bombardment can be investigated by studying the backscattered yield from crystals bombarded with "probe" beams of, for example, He^+ ions. This method is described and typical results are presented together with electrical measurements such as the mobility of carriers in the implanted layers. Damage in the crystal can also be studied using electron diffraction and electron microscopy, and some of the work in this field is described. In addition, the potential advantages and uses of ion implantation are outlined with reference to some of the semiconductor devices that have already been made using this technique. (auth) (UK)

51776 CONFERENCE ON COLOR CENTERS, SACLAY, FRANCE, MARCH 16–18, 1967. J. Phys. (Paris), 28: Colloq. C4, 1-188(Aug.-Sept. 1967). (In French and English). (CONF-670331).

Separate abstracts were prepared for the 14 papers considered in scope for NSA; i.e., those pertaining to radiation-induced defects. Eighteen other papers deal with general aspects of color centers and were not included. (D.L.C.)

For abstracts of individual papers see: 51777–51790.

51777 INTERSTITIAL LITHIUM CENTER IN IRRADIATED LITHIUM FLUORIDE. Farge, Y. (Laboratoire de Physique des Solides, Orsay, France). J. Phys. (Paris), 28: Colloq. C4, 34-8(Aug.-Sept. 1967). (In French).

From Conference on Color Centers, Saclay, France. See CONF-670331.

An absorption band at 5500 Å appears in lithium fluoride crystals heavily irradiated with 1.4-MeV electrons at 77°K. The number of centers associated with this band increases proportionally to the irradiation dose; the center, a primary effect of irradiation, could be the lithium interstitial which could form a Li_2^+ molecular ion with a lithium neighbor. (auth)

51778 LOCALISED ELECTRONIC STATES OF DEFECT AGGREGATES IN NEUTRON-IRRADIATED MAGNESIUM OXIDE. Henderson, B. (Univ. of Keele, Eng.); King, R. D. J. Phys. (Paris), 28: Colloq. C4, 75-80(Aug.-Sept. 1967).

From Conference on Color Centers, Saclay, France. See CONF-670331.

The alkaline earth oxides have the same crystal structure as the alkali halides and consequently, defects with electronic states and symmetry properties analogous with the M and R centers are observed after neutron irradiation. The divalent nature of the host lattice also offers additional potential for electron trapping: in this respect the R-like centers have been especially interesting. The application of uniaxial stress techniques has confirmed that optical zero-phonon lines at 5248 Å, 6419 Å, and 6490 Å in neutron-irradiated MgO single crystals are associated with such centers. The line at 5248 Å is strongly dichroic under stress at 4°K and the results are indicative of E → A transitions. The lack of such dichroic behavior in the 6419 Å and 6490 Å lines confirms that these lines are associated with A → E transitions. Calculations of the electronic states of these trigonal defects suggest that the 5248 Å, 6419 Å, and 6490 Å lines are due to clusters of three anion vacancies lying in a (111) plane and containing 5, 6, and 7 electrons, respectively. In addition to defects readily recognized on account of their M- and R-like characteristics, there are defects that are not analogous with any defects so far identified in the alkali halides. Two such defects have spin triplet states (S = 1) at 300°K, but have spin singlet states at 4°K. Models for these defects involve exchange-coupled pairs of F-centers in next nearest neighbor association along the [100] axes (tetragonal symmetry) and [110] axes (orthorhombic symmetry). A third defect, designated the F_2-center by Wertz, has optical properties in accord with those expected for a single electron bound to an anion–cation vacancy pair. More recent paramagnetic resonance measurements at the Q band strongly support the proposed model for this defect. (auth)

51779 STUDY OF CENTERS THAT APPEAR IN POTASSIUM CHLORATE IRRADIATED BY X RAYS. Fayet, J.-C.; Thieblemont, B. (Laboratoire de Physique Cristalline, Orsay, France). J. Phys. (Paris), 28: Colloq. C4, 93-7(Aug.-Sept. 1967). (In French).

From Conference on Color Centers, Saclay, France. See CONF-670331.

Three paramagnetic centers were studied in $KClO_3$ crystals. They may be described as ClO_2, O_3 radicals, and as a two-chlorine center designated by "Cl–ClX." Their optical absorption bands lie at 315 mμ, 445 mμ, and 460 mμ, and the dichroism was determined. Illumination with 436-mμ polarized light leads to the transformation of the Cl–ClX center into a Cl_2^- center, whose EPR spectra and optical absorption have been studied. Illumination with shorter-wavelength light destroys the ClO_2 center. (auth)

51780 ESR STUDY OF A NEW POINT DEFECT IN LiF. Bacquet, G.; Dugas, J.; Gautier, P. (CNRS, Toulouse). J. Phys. (Paris), 28: Colloq. C4, 100-2(Aug.-Sept. 1967). (In French).

From Conference on Color Centers, Saclay, France. See CONF-670331.

After heating and quenching, x-irradiated samples of LiF containing divalent impurities exhibit ESR spectra with a hyperfine structure characteristic of interaction of an unpaired electron with the six nearest neighbor fluorines. (auth)

51781 CONCENTRATION OF UNPAIRED ELECTRONS IN IRRADIATED LITHIUM FLUORIDE. Van den Bosch, A.; Schotsmans, L. (CEN-Mol, Belgium). J. Phys. (Paris), 28: Colloq. C4, 115-19(Aug.-Sept. 1967). (In French).

From Conference on Color Centers, Saclay, France. See CONF-670331.

In thermal-neutron-irradiated single crystals of lithium fluoride, the paramagnetic part of the susceptibility which obeys the Curie law is attributed to unpaired electrons. The concentration of these electrons is calculated by the Monte Carlo method on the basis of a simplified model. In this model, "primary" paramagnetic defects are created at random in the lattice. Two of them, when close to each other, form "pairs." Two kinds of pairs are considered. The maximum concentration of free radicals seems to depend only on the thickness of the inert medium, which is necessary for isolating the primary centers. The results of statistical calculations, carried out with five mono-atomic layers of inert material, are close to those obtained by interpreting the magnetic measurements. (auth)

51782 DIELECTRIC AND OPTICAL PROPERTIES IN ALKALI HALIDES DOPED WITH COBALT. Cappelletti, R.; Fieschi, R.; Martegani, G.; Pirola, L. (Univ., Parma, Italy). J. Phys. (Paris), 28: Colloq. C4, 130-4(Aug.-Sept. 1967).

From Conference on Color Centers, Saclay, France. See CONF-670331.

The influence of Co addition in NaCl crystals is studied by means of dielectric and optical measurements. Depolarization currents (ionic thermal conductivity) due to the presence of "cobalt impurity cation vacancy" dipoles are detected, and the effect of isothermal annealing on the dipole concentration is studied. The precipitation process which is observed has a third-order kinetics,

according to the results on the alkaline earth impurities. Optical absorption bands due to Co additions are detected. The presence of Co impurities catalyzes the formation of F centers, just as the presence of alkaline earth impurities, when the sample is x-irradiated. Nothing analogous to the Z bands is found. (auth)

51783 PROPERTIES OF NaCl CRYSTALS DOPED WITH CALCIUM. Tarjan, I.; Voszka, R.; Siegler, A.; Berkes, L. (Institut de Physique Medicale, Budapest). J. Phys. (Paris), 28: Colloq. C4, 135-7(Aug.-Sept. 1967). (In French).

From Conference on Color Centers, Saclay, France. See CONF-670331.

Under the influence of x-ray coloration, the dark current of a Ca-doped NaCl crystal first decreases, then approaches a constant value. The ratio of the dark current of an uncolored crystal to the saturation value is 2.5. The photocurrent of a NaCl crystal containing Ca decreases with increasing Ca content. From the experimental data it follows that in the course of the coloration process there arises a center in the vicinity of the Ca^{2+} ions, which contributes to the dark current. (auth)

51784 FORMATION OF F, M, AND R CENTERS IN LITHIUM FLUORIDE. Durand, P.; Farge, Y.; Lambert, M.; Smoluchowski, R. (Faculte des Sciences, Orsay, France). J. Phys. (Paris), 28: Colloq. C4, 154-7(Aug.-Sept. 1967). (In French).

From Conference on Color Centers, Saclay, France. See CONF-670331.

The formation of M and R centers in LiF is preceded by the formation of F_2^+ and F_3^+ centers out of α and F, α and M centers at temperatures near room temperature. The number of F-centers is then proportional to the square root of the irradiation time, the constant being a decreasing function of temperature. (auth)

51785 EXPERIMENTS ON DEVELOPMENT OF COLOR CENTERS IN LiF UNDER THE COMBINED INFLUENCE OF TEMPERATURE AND PLASTIC DEFORMATION. Serughetti, J.; Schaeffer, B.; Dupuy, C. H. S.; Saucier, H. (Faculte des Sciences, Strasbourg). J. Phys. (Paris), 28: Colloq. C4, 158-62(Aug.-Sept. 1967). (In French).

From Conference on Color Centers, Saclay, France. See CONF-670331.

Plastic deformation of γ-irradiated LiF single crystals gives, at room temperature, an absorption band at $\lambda = 545$ mμ (N_2) and increases the absorption peak of the 440 mμ band (M). These bands are anisotropic. Similar results are found on crystals thermally annealed at 250°C; however, the 525 mμ band (N_1) decreases with plastic deformation. For some crystals deformed at 150°, 250°, and 300°C, variations of the absorption band of any given centers were not observed; however, the 400°C thermal annealing of these crystals shows that the deformed zones are darker than the other parts of the crystals. The F and M center "persistence" increases linearly with the plastic strain. (auth)

51786 PRODUCTION AND THERMAL ANNEALING OF LATTICE DEFECTS IN KCl. Behr, A.; Peisl, H.; Waidelich, W. (Technische Hochschule, Darmstadt, Ger.). J. Phys. (Paris), 28: Colloq. C4, 163-7(Aug.-Sept. 1967).

From Conference on Color Centers, Saclay, France. See CONF-670331.

Some investigations were performed to obtain more information about the production of defects in alkali metal halides during x irradiation. Combined measurements of the macroscopic volume change and the change of the lattice parameter of KCl were performed. Color centers in additively colored KCl are formed from Schottky-defect vacancies, whereas in x-irradiated KCl they are formed from vacancies which are parts of Frenkel defects. Further, the production of vacancies, i.e., α plus F centers by x rays in KCl of different origins, dislocation densities, and of different divalent impurities, is studied at liquid helium temperature. It is concluded that the generation of vacancies at liquid helium temperature is an intrinsic process. The annealing behaviour of α, F, and H centers and the annealing of an absorption band at 195 nm shows that during x irradiation at liquid helium temperature, vacancies and interstitials are formed in KCl which recombine in distinct annealing stages. An analysis of the annealing curves gives the activation energy and the order of reaction. It is concluded from combined irradiation and annealing experiments at liquid helium and at liquid nitrogen temperature that the same primary process should be valid for the defect formation at liquid helium and at liquid nitrogen temperature. (auth)

51787 "MECHANICAL" EFFECT OF IONIZING RADIATION IN KCl CRYSTALS. Damm, J. Z.; Suszynska, M. (Polish Academy of Sciences, Wroclaw). J. Phys. (Paris), 28: Colloq. C4, 168-74(Aug.-Sept. 1967).

From Conference on Color Centers, Saclay, France. See CONF-670331.

Potassium chloride crystals of various origin, both as received and plastically deformed, were colored by hard or soft ionizing radiation. Based on measurements of microhardness and absorption spectra, the existence of some secondary effects of ionizing radiation resembling the effects of ordinary plastic deformation is pointed out. The "mechanical" effect of hard ionizing radiation is found to resemble that of plastic deformation within the easy glide range and the effect of soft radiation is found to be comparable with that of plastic deformation within the strain-hardening range. A mechanism responsible for the radiation-induced plastic deformation of crystals is proposed and some experimental data are discussed. (auth)

51788 NEW EVIDENCE FOR THE MODEL AND THE PROCESS OF FORMATION OF Z_1 CENTERS. Giuliani, G. (Univ., Pavia, Italy). J. Phys. (Paris), 28: Colloq. C4, 175-7(Aug.-Sept. 1967).

From Conference on Color Centers, Saclay, France. See CONF-670331.

Z_1 centers were produced in strontium-doped KCl by a new method which allows one to send negative ion vacancies and electrons separately through the crystal. This new method of producing Z_1 centers confirms that the Z_1 center contains an F center as a component and gives direct experimental evidence for the existence of an intermediate product in the Z_1 center formation. This intermediate product is an ionized Z_1 center and gives rise to a localized exciton band peaking at 172.5 mμ. (auth)

51789 TEMPERATURE DEPENDENCE OF THE EFFICIENCY OF RADIOLUMINESCENCE AND COLOR CENTER GENERATION IN LiF CRYSTALS. Shvarts, K.; Podin, A.; Aluker, E.; Intenberg, L.; Tchernov, S. (Inst. of Physics, Riga). J. Phys. (Paris), 28: Colloq. C4, 178-81(Aug.-Sept. 1967).

From Conference on Color Centers, Saclay, France. See CONF-670331.

The efficiency of color-center generation and the radioluminescence yield in lithium fluoride crystals of varying purity and also in uranium-doped crystals (LiF-U) were investigated in the region of temperature from 100 to 400°K. It is shown that the efficiency of F- and X_3^--centers generation depends on the crystal purity. The investigation of the temperature dependence of radioluminescence yield η_L shows that there is abatement of $\eta_L(T)$ in all crystals in region where holes became self-trapped. Luminescence spectra were measured during excitation by 10-μsec electron pulses and after excitation at different temperatures. On the basis of obtained data, the role of the electron–hole processes in color-center generation and in radioluminescence in LiF crystals is discussed. (auth)

51790 OBSERVATIONS ON THE L_1 BANDS IN THE PHOTOEMISSION SPECTRA OF RbBr AND KI. Petresco, P. (Institut de Physique). J. Phys. (Paris), 28: Colloq. C4, 182-5(Aug.-Sept. 1967). (In French).

From Conference on Color Centers, Saclay, France. See CONF-670331.

The photoemission of RbBr and KI crystals colored by electron bombardment was analyzed. A very intense L_1 band was observed at the corresponding position of the absorption spectrum. The evolution of the electron emission spectra as a function of F and L_1 irradiation is studied. (auth)

Physical Properties

Refer also to abstract 51724.

51791 TEMPERATURE DEPENDENCE OF THE PITCH OF THE MAGNETIC HELIX IN RARE-EARTH METALS. Mandzhavidze, A. G.; Kharadze, R. A. (Inst. of Physics, Tbilisi, USSR). JETP Lett. (USSR) (Engl. Transl.), 10: 44-5(July 20, 1969).

Translated from Zh. Eksp. Teor. Fiz. Pis'ma Redaktsiyu, 10: 68-71(July 20, 1969).

Scattering of a monochromatic beam of thermal neutrons by polycrystalline samples of dysprosium and holmium was observed in the vicinity of the small-angle magnetic satellite (momentum transfer $\vec{q} - \vec{K}_0$) at $T \simeq T_N$, the Neel temperature. (M.H.R.)

51792 INTERFERENCE BETWEEN ONE- AND MULTIPHONON PROCESSES IN THE SCATTERING OF NEUTRONS AND X-RAYS BY CRYSTALS. Crowley, R. A.; Svensson, E. C.; Buyers, W. J. L. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Phys. Rev. Lett., 23: 525-8(Sept. 8, 1969).

It is shown that the intensity of x-ray and neutron scattering by anharmonic crystals is markedly affected by the interference between one- and multiphonon scattering processes. The previously

unexplained intensity modulation in the x-ray diffuse scattering from NaCl is shown by calculations to be largely of this origin. The effect of the interference in neutron inelastic scattering from KBr was also observed, calculations give quantitative agreement with the experimental results. (auth)

51793 RULES FOR INELASTIC NEUTRON SCATTERING IN RUTILE CRYSTALS. Usov, O. A.; Bir, G. L. (Inst. of Semiconductors, Leningrad). Fiz. Tekh. Poluprov., 3: 1188-91(1969). (In Russian).

A group method was used for obtaining selection rules for inelastic neutron scattering in rutile crystals. It was shown that data on the nature of the point groups and direction of the group wave vectors are sufficient for obtaining the selection rules for the points inside the Brillouin zone. (R.V.J.)

51794 EFFECT OF PRESSURE ON THE FERMI SURFACE OF Be. Schiber, J. E.; O'Sullivan, W. J. (Sandia Labs., Albuquerque, N. Mex.). Phys. Rev., 184: 628-34(Aug. 15, 1969).

Measurements of the effect of hydrostatic pressure on five cross-sectional areas of the Fermi surface of Be are presented. The cross sections were determined from de Haas–van Alphen frequencies obtained with the field-modulation technique. Pressure derivatives were obtained in both solid He to ~4 kbar and in fluid He, and results from the two pressure techniques were in excellent agreement in all cases. The most striking result is that for H‖[0001] the waist of the third-zone electron surface decreases while the hips of this surface increase. This behavior cannot be explained even in qualitative terms by free-electron considerations and is at variance with results inferred from recent magnetostriction data. The results, however, are in substantial agreement with recent calculations by Tripp, Everett, Gordon, and Stark. (auth)

51795 EXPERIMENTAL INVESTIGATION OF INTEGRAL SEMISPHERICAL DEGREES OF BLACKNESS OF MOLYBDENUM AT HIGH TEMPERATURES. Peletskii, V. E.; Druzhinin, V. P. Teplofiz. Vys. Temp., 7: 65-70(Jan.-Feb. 1969). (In Russian).

An experimental apparatus is described for calorimetric measurement of degrees of blackness using electronic heating. The accuracy of the experiment was evaluated to be 5%. In the temperature range from 1200 to 2100°C the forms and surface treatments of molybdenum were studied. Results of the investigation were compared with literature data. (tr-auth)

51796 PHASE RELATIONS, CRYSTAL STRUCTURES, AND MAGNETIC PROPERTIES OF ERBIUM–IRON COMPOUNDS. Buschow, K. H. J.; van der Goot, A. S. (Philips' Research Labs., Eindhoven, Netherlands). Phys. Status Solidi, 35: 515-22(Sept. 1, 1969).

The phase relations, crystal structures, and magnetic properties of intermetallic compounds occurring in the Er–Fe system have been investigated. A phase diagram is given. The lattice constants of the compounds $ErFe_2$, $ErFe_3$, Er_6Fe_{23}, and Er_2Fe_{17} have been determined. These compounds are ferrimagnetic with the Fe moments coupled antiparallel to the Er moments. Their Curie temperatures decrease with increasing Fe concentration. The compounds $ErFe_2$, $ErFe_3$, and Er_6Fe_{23} have been observed to show a compensation point. (auth)

51797 EVIDENCE FOR THE COULOMB INTERACTION OF Be VALENCE ELECTRONS BY COMPTON SCATTERING CROSS-SECTION MEASUREMENTS. Schuelke, W.; Berg, U.; Bruemmer, O. (Martin Luther Univ., Halle, Ger.). Phys. Status Solidi, 35: 227-36(Sept. 1, 1969).

The effect of Coulomb interaction on the Compton scattering cross section (CSCS) of a free electron gas has been calculated theoretically by Ohmura and Matsudaira within the framework of the random phase approximation (RPA). These calculations have shown that plasmon emission during the scattering process diminishes the CSCS against its value within the Hartree–Fock approximation, which neglects the Coulomb interaction. A method is presented to measure relative values of the CSCS of metal valence electrons by separating the core electron part from the valence electron part of the Compton line profile. The relative values of the CSCS have been brought onto an absolute scale by means of a sum rule for the imaginary part of the dielectric constant given by Nozière and Pines. The measured values of the CSCS of Be valence electrons are in good agreement with the RPA calculations of Ohmura and Matsudaira. (auth)

51798 ISOTOPE EFFECT AND DIVACANCIES FOR SELF-DIFFUSION IN COPPER. Rothman, S. J.; Peterson, N. L. (Argonne National Lab., Ill.). Phys. Status Solidi, 35: 305-12(Sept. 1, 1969).

The simultaneous diffusion of ^{64}Cu and ^{67}Cu has been measured in copper single crystals from 890 to 1061°C. The strength of the isotope effect f ΔK is 0.684 ± 0.014 and is independent of temperature within the experimental error. This indicates that the contribution of divacancies to self-diffusion in copper is small. The diffusion coefficient of ^{67}Cu in copper single crystals was measured from 700 to 1060°C and is given by $D = 0.78 \exp\{-(2.19 \pm 0.01)/kT\}$ cm²/sec. (auth)

51799 NEUTRON-DIFFRACTION MEASUREMENTS ON ANTIFERROMAGNETIC UOTe AT 4.2 °K. Murasik, A.; Suski, W.; Leciejewicz, J. (Inst. of Nuclear Research, Warsaw. Inst. of Low Temperatures and Structural Research, Wroclaw). Phys. Status Solidi, 34: K157-62(Aug. 1, 1969).

The magnetic structure of UOTe was investigated at 4.2 and 78°K. The magnetic moments derived from the neutron diffraction peaks are given. The configurational symmetry of the magnetic unit cell and the atomic coordinates are listed. The structure belongs to P4/n′m′m′, and the space group is P4/nmm. (D.L.C.)

51800 HEAT-CAPACITY MEASUREMENTS ON RARE-EARTH DOUBLE OXIDES $R_2M_2O_7$. Bloete, H. W. J.; Wielinga, R. F.; Huiskamp, W. J. (Kamerlingh Onnes Laboratorium, Leiden). Physica, 43: 549-68(Sept. 1, 1969).

A discussion is given on the results of heat-capacity measurements below 2°K on rare-earth double oxides with the general formula $R_2M_2O_7$, where R stands for Nd, Tb, Dy, Ho, Er, and Yb and M_2 stands for Ti_2^{4+}, Sn_2^{4+}, Zr_2^{4+}, or $Ga^{3+}Sb^{5+}$, respectively. Magnetic long-range ordering was observed for most of the odd-electron rare-earth ions at low temperatures, while Schottky-type anomalies in the heat capacities predominate in the Tb and Ho compounds. Data on powder susceptibilities at low temperatures are mentioned as well. (auth)

51801 PHOTOLUMINESCENCE OF OXYGEN IN ZnTe INTRODUCED BY ION IMPLANTATION. Merz, J. L.; Feldman, L. C. (Bell Telephone Labs., Inc., Murray Hill, N. J.). Appl. Phys. Lett., 15: 129-31(Sept. 1, 1969).

Photoluminescence has been observed from oxygen (^{16}O) ions implanted into ZnTe. Doses of 5×10^{13} oxygen ions/cm² were implanted at room temperature with energies between 50 and 250 keV. After annealing at 300–400°C in zinc vapor, the characteristic photoluminescence spectrum from the oxygen isoelectronic trap was observed. Care was taken to ensure that the spectrum was a direct result of the implanted oxygen by studying unimplanted and neon-implanted samples. The anticipated isotope shift was observed in the spectrum for samples implanted with ^{18}O. (auth)

51802 ENTHALPY AND HEAT CAPACITY OF SESQUIOXIDES OF LANTHANUM AND LUTETIUM AT HIGH TEMPERATURES. Yashvili, T. S.; Tsagareishvili, D. Sh.; Gvelesiani, G. G. (Inst. of Metallurgy, Moscow). Teplofiz. Vys. Temp., 6: 817-20(Sept.-Oct. 1968). (In Russian).

Results are given from the method of mixing in the massive calorimetric apparatus for enthalpies of sesquioxides of lanthanum and lutetium in the temperature range 298.15 to 1600°K. Interpolation equations and composition tables with smoothed values of the enthalpies in 100° steps are given. Duplicate mean square errors of the measurements do not exceed 0.24%. (tr-auth)

51803 INVESTIGATION OF THERMODYNAMIC PROPERTIES OF LANTHANUM HEXABORIDE. Gordienko, S. P.; Guseva, E. A.; Fesenko, V. V. (Inst. of Mathematical Problems, Kiev). Teplofiz. Vys. Temp., 6: 821-5(Sept.-Oct. 1968). (In Russian).

Mass spectrometric techniques were used to determine the partial pressure of La vapor over LaB_6 in the range 2045 to 2300°K. The change in thermal capacity was measured at 1340 to 2300°K by the method of mixtures. The thermodynamic properties and the standard heat of formation were next determined for LaB_6 in the range 298 to 2500°K. (tr-auth)

51804 DETERMINATION OF THE SPECTRAL COEFFICIENTS OF EMISSION OF TANTALUM–NIOBIUM ALLOYS. Kotlyar, A. A.; Voskoboinik, Ts. V. Teplofiz. Vys. Temp., 6: 830-3(Sept.-Oct. 1968). (In Russian).

The method is described and results given for measurement of the spectral coefficient of emission (at effective wavelength 0.65 ± 0.01 μ) for niobium–tantalum alloys in the temperature range 1300 to 2000°K. (tr-auth)

51805 A FURTHER CONSIDERATION OF THE ISOTOPE EFFECT FOR SELF-DIFFUSION IN FCC METALS BY A DI-VACANCY MECHANISM. Bakker, H. (Univ., Amsterdam). Phys. Status Solidi, 34: K153-5(Aug. 1, 1969).

The sufficient and necessary condition for the isotope effect E to equal the correlation factor f, is $f = a/(a + w)$, where a = constant and w = jump frequency. At high temperature, divacancies

may contribute to the diffusion in fcc metals. Manipulations of Howard's equation for the correlation factor result in $f_2 = 1/(1 + 1.10606\delta)$, where δ = ratio of jump frequency of tracer to that of the host atoms. This condition is shown to be sufficient but not necessary for the divacancy mechanism. (D.L.C.)

51806 COHESIVE ENERGY OF SURFACE ATOMS OF TUNGSTEN ON VARIOUS CRYSTAL PLANES. Richman, Marc Herbert (Brown Univ., Providence). Jap. J. Appl. Phys., 8: 1273-4(Oct. 1969).

The simplified bonding and recombination model is used to calculate bond energies for the {100}, {110}, {111}, and {112} planes of tungsten. The calculated interatomic energies and experimental binding energies agree with those of Tamaki and Kuroda (Japan. J. Appl. Phys., 7: 1202(1968)). Guidelines for the recombination of surface bonds are listed. (D.L.C.)

51807 NEUTRON DEPOLARIZATION STUDY ON DYSPROSIUM AND TERBIUM. Loeffler, E.; Rauch, H. (Oesterreichische Hochschule, Vienna). J. Phys. Chem. Solids, 30: 2175-86 (Sept. 1969).

The neutron depolarization of a polycrystalline 0.25 mm thick dysprosium foil was measured in the temperature range from 4.2 to 300°K in external magnetic fields up to 2.2 kOe. From 85 to ~130°K, where Dy should behave as an antiferromagnet, domains with a net magnetic moment were found to exist in the antiferromagnetic material. Above 130°K, the depolarization effect was very small, indicating that only a few domains are present. In the ferromagnetic region (T < 85°K), calculation of the domain size from the depolarization data is possible. The domains were found to be very small ($\sim 10^{-6}$–5×10^{-5} cm) and grew with the applied field, H, as expected. If the sample was cooled in zero field and then H was applied, a sort of internal coercive force for the Bloch-wall mobility was observed. The depolarization and, hence, the size of the domains were found to be very sensitive to the magnetic field acting on the sample during the cooling process. The depolarization measurements on terbium were combined with measurements of the small-angle scattering, so that the induction, B, in the domains and the mean domain size were obtained separately. The values B found in this way were lower than those corresponding to the saturation magnetization. (auth) (UK)

51808 INELASTIC NEUTRON SCATTERING INVESTIGATION OF SPIN WAVES AND MAGNETIC INTERACTIONS IN Cr_2O_3. Samuelsen, E. J.; Hutchings, M. T.; Shirane, G. (Brookhaven National Lab., Upton, N. Y.). Solid State Commun., 7: 1043-5 (Aug. 1969).

The dispersion relation E (q) for spin waves in antiferromagnetic Cr_2O_3 was measured in various directions within the rhombohedral $(1\bar{1}0)$ plane at 78°K. The observed E (q) is interpreted in terms of Heisenberg exchange interactions between the Cr^{3+} ions. Only interactions between first and second neighbor ions are found to be strong. (auth) (UK)

51809 CONCERNING THE FERMI SURFACE OF NIOBIUM. Alekseevskii, N. E.; Bertel, K. Kh.; Dubrovin, A. V. (Inst. of Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.), 10: 74-6(Aug. 5, 1969).

Translated from Zh. Eksp. Teor. Fiz. Pis'ma Redaktsiyu, 10: 74-6(Aug. 5, 1969).

Results of an investigation of the galvanometric properties of single-crystal niobium with room-temperature to helium-temperature resistance ratios from 400 to 1000 were reported earlier (JETP Lett. (USSR) (Engl. Transl.), 6: 132(1967)). On the basis of the data obtained at that time one could conclude that the Fermi surface of niobium is a grid of corrugated cylinders whose axes are parallel to the fourfold axes of the crystal. Since the purity of these niobium samples was relatively low, the measurements were repeated on purer samples. Niobium samples with $\alpha = r(300°K)/r(4.2°K) = 30{,}000$ were obtained. The data on these samples are presented. The two-dimensional regions of open directions should now be located not only in the vicinity of fourfold axes, but also in the vicinity of twofold and threefold axes, the widths of these regions being much smaller than those of the former. (M.H.R.)

Moessbauer Effects and NMR

51810 NUCLEAR MAGNETIC RESONANCE OF ^{31}P IN THE ANTIFERROMAGNETIC STATE OF METALLIC URANIUM MONOPHOSPHIDE. Carr, S. L. (Florida State Univ., Tallahassee); Long, C.; Moulton, W. G.; Kuznietz, Moshe. Phys. Rev. Lett., 23: 786-8(Oct. 6, 1969).

The ^{31}P nuclear magnetic resonance in the antiferromagnetic state of metallic uranium monophosphide ($T_N \simeq 123°K$) was observed in a zero external field over the temperature range 1.3 to 111°K. The frequency of the line changes from 46.82 MHz below 22.9 ± 0.1°K to 42.01 MHz above, in agreement with the jump in moment found by neutron diffraction. (auth)

51811 NEW MOESSBAUER LEVELS IN THE RARE EARTHS FOLLOWING COULOMB EXCITATION. Stevens, Ralph Robert Jr. Baltimore, Johns Hopkins Univ., 1966. 116p.

Thesis.

A series of Moessbauer experiments were carried out in the rare earths using Coulomb excitation to populate the excited states of the nuclei being studied. New Moessbauer levels were observed in ^{160}Gd, ^{164}Dy, ^{168}Er, and ^{174}Yb. Moessbauer spectra following Coulomb excitation were also observed in ^{155}Gd, ^{156}Gd, and ^{158}Gd. Moessbauer studies were also carried out in the first and second excited states of ^{155}Gd using a $^{155}Eu_2O_3$ radioactive source. These studies place a lower limit of 0.22 nsec on the lifetime of the first excited state. Hyperfine structure observed for the second excited state implies a spin of $\frac{1}{2}$ for this state and a quadrupole coupling of $(0.95 \pm 0.02) \times 10^{-6}$ eV for the ground state of ^{155}Gd in Gd_2O_3. The Moessbauer spectra obtained following Coulomb excitation of the even–even isotopes of gadolinium exhibited broadened absorption peaks due to unresolved quadrupole splitting of the first excited states of these isotopes. The quadrupole interaction energies were extracted from these data and compared to the quadrupole coupling energy obtained for the ground state of ^{155}Gd to give relative quadrupole moments. The ratios of quadrupole moments thus obtained agreed within the experimental errors with the corresponding ratios obtained from Coulomb excitation data, and thus these measurements provide further experimental confirmation of the collective theory of deformed nuclei. Well-resolved magnetic hyperfine structure was observed in ^{164}Dy and ^{168}Er. An estimate of the magnetic energy splitting for ^{164}Dy in Dy_2O_3 of $(6.3 \pm 0.2) \times 10^{-6}$ eV was obtained. For ^{168}Er in metallic erbium, a magnetic energy splitting of $(7.8 \pm 0.4) \times 10^{-6}$ eV and a quadrupole interaction energy of $(0.9 \pm 0.4) \times 10^{-6}$ eV were obtained. Using a theoretical value for the internal magnetic field in metallic erbium, a value for g_R of (0.33 ± 0.02) was obtained, which is in agreement with the value predicted by the collective model. Additional structure was observed in both the dysprosium and erbium Moessbauer spectra which may be attributable to radiation damage effects in the target. Unresolved quadrupole structure was observed in the Moessbauer absorption spectrum obtained for ^{174}Yb and a quadrupole interaction energy of $(1.51 \pm 0.05) \times 10^{-6}$ eV was obtained. (Disser. Abstr.)

51812 ^{161}Dy ISOMER SHIFTS IN DYSPROSIUM COMPOUNDS. Abeles, Tom P.; Bos, William G.; Ouseph, P. J. (Univ. of Louisville, Ky.). J. Phys. Chem. Solids, 30: 2159-68(Sept. 1969).

Moessbauer absorption spectra were obtained for the 25.7-keV transitions of ^{161}Dy in dysprosium metal and several compounds at room temperature. Isomer shifts relative to DyF_3 are: Dy (metal), 3.05 mm sec^{-1}; DyN, 0.85 mm sec^{-1}; Dy_2O_3, 0.56 mm sec^{-1}; $DyH_{2.9}$, 0.55 mm sec^{-1}; $DyH_{2.1}$, 0.50 mm sec^{-1}; $DyF_3 \cdot \frac{1}{2}H_2O$, −0.04; and $Dy_2(SO_4)_3 \cdot 8H_2O$, −0.46 mm sec^{-1}. The relative isomer shifts of these compounds are attributed to varying degrees of covalency. The isomer shifts for the hydrides are compared to the predictions of the protonic and hydridic models for these compounds and appear to favor the hydridic model. (auth) (UK)

51813 THE PARAMAGNETIC RESONANCE OF Er^{3+} AND Ce^{3+} IN Y_2O_3. Schaefer, G. (Technische Hochschule, Darmstadt, Ger.). Phys. Kondens. Mater., 9: 359-66(Sept. 3, 1969). (In German).

The paramagnetic resonance of trivalent Er and Ce in single crystals of Y_2O_3 on sites of crystal field symmetry C_3 and C_2 is investigated at 9.5 kMc/s. For Er^{3+} ions, results completing formerly published data are given. For Ce: Y_2O_3 the measured values of the g tensors are: $g_\parallel = 0.394$ and $g_\perp = 1.633$ for C_{3i} sites and $g_z = 0$, $g_x = 2.938$, $g_y = 0.819$ for C_2 sites. For ions on sites of symmetry C_2, the principal axes x and y of g are tilted 29.7° against the [100] directions. (auth)

Theoretical Physics

Refer also to abstracts 51657, 51868, 51894, 51965, and 52005.

51814 (AD-690168) BINDING EFFECTS IN THE SLOWING DOWN SPECTRUM FOR HARD SPHERES. Report No. Scientific-1. Sherman, Charles H.; Gordon, Nan E. (Parke Mathematical Labs., Inc., Carlisle, Mass.). Apr. 1969. Contract F19628-68-C-0188. 35p. (AFCRL-69-208). CFSTI.

The special form of the transport equation in which all variables except the energy was averaged out is derived as an equilibrium condition. This equation, often called the energy degradation equa-

tion, is then applied to the problem of hard spheres slowing down in a collection of hard spheres, and the flux spectrum is calculated. The effects of binding on the spectrum are then investigated, still using the hard sphere interaction. These effects are illustrated by various numerical results which suggest that adequate consideration of binding in the corresponding problem of electron slowing down may explain discrepancies between measurements and previous calculations. (auth) (USGRDR)

51815 GREEN'S FUNCTIONS FOR QUANTUM FERMI SYSTEMS OF COLLIDING CHARGED PARTICLES. Mel'nikov, V. N. (Moscow State Univ.). Dokl. Akad. Nauk SSSR, 179: 55-8(1968). (In Russian).

Studies were made of the charged Fermi particles interacting according to the Coulomb law and found in a compensating field of a charge with a different sign. The D function, in this case, is taken in contrast to the Bogolyubov distribution function as normalized on n instead of the 1. (R.V.J.)

51816 GEOMETRY OF QUANTUM THEORY. VOLUME I. Varadarajan, V. S. The University Series in Higher Mathematics. Princeton, N. J., D. Van Nostrand Company, Inc., 1968. 205p.

This volume approaches quantum theory from the geometrical point of view, using projective geometry, Hilbert space theory, and representations of locally compact groups. The volume is in two parts: (1) Von Neumann's formulation is introduced and complemented lattices are examined. (2) The structure of the logic of quantum mechanical systems is analyzed. (D.L.C.)

51817 AN EXPANSION FORMULA FOR MEIJER'S G-FUNCTION INVOLVING LEGENDRE FUNCTIONS. Bajpai, S. D. (Shri G. S. Technological Inst., Indore, India). Proc. Nat. Inst. Sci. India, Part A, 35: Suppl. 1, 90-4(Feb. 1969).

An expansion for Meijer's G function involving Legendre functions is established. From this expansion an expansion for MacRobert's E function is deduced. An expansion for regular radial Coulomb wave functions is also derived. (auth)

51818 TABLE OF INTEGRALS OF THE ERROR FUNCTIONS. Ng, Edward W.; Geller, Murray (California Inst. of Tech., Pasadena). J. Res. Nat. Bur. Stand., 73B: 1-24(Jan.-Mar. 1969).

This is a compendium of indefinite and definite integrals of products of the Error function with elementary or transcendental functions. A substantial portion of the results are new. (auth)

51819 SOLUTION OF THE THEORY FOR THE QUANTUM-MECHANICAL FOUR-BODY PROBLEM. Buettner, W.; Ruder, H. (Univ., Erlangen, Ger.). Z. Naturforsch., 24a: 1163-71 (Aug. 1969). (In German).

A system of 4 point masses (without spin) is considered. The potential energy is assumed to be a function of the distances between the particles only. It is possible to express the kinetic energy relative to the center of mass as the kinetic energy of 3 "reduced" masses. The different possibilities for that procedure are discussed for systems with an arbitrary number of particles. The positions of the 3 reduced masses are described by 9 coordinates; 6 of them, the "internal" coordinates, are needed to determine the internal structure of the system, and 3, the "external" coordinates, for its orientation in space. The classical Hamiltonian in such a set of coordinates is derived. In a first step, the Hamiltonian is expressed in terms of linear and angular momenta. Then, these quantities are determined as functions of the coordinates and the conjugate momenta by infinitesimal transformations. From the classical Hamiltonian the quantum mechanical one is obtained by the well known translation rule. It can be expressed in terms of the linear and angular momentum operators quite analogous to the classical case. For the solution of the time-independent Schrödinger equation the rotational symmetry of the system is used. The wave function is expanded in terms of the eigenfunctions of the total angular momentum. This leads to a system of coupled differential equations for the expansion coefficients, which depend on the 6 internal coordinates only. The further symmetries of the system (reflection and particle exchange) appear in symmetry properties of these functions. Differences and similarities in the solution theory for the 4-body-problem with respect to the 3-body-problem are discussed. (auth)

51820 SIMPLE DENSE FLUIDS. Frisch, H. L.; Salsburg, Z. W. (eds.). New York, Academic Press, Inc., 1968. 445p. $19.50.

The best data available for the statistical mechanics of simple dense fluids are presented in tabular and graphical form and are given some theoretical context to indicate their importance to the development of current ideas about the liquid state. Topics covered are: thermodynamic functions along the orthobaric liquid line, the surface tension of simple fluids, x-ray scattering studies of simple fluids, light scattering from simple dense fluids, neutron scattering results, the electromagnetic equation of state data, nuclear relaxation in single liquids, spectroscopy in simple liquids, and comments on the experimental and theoretical study of transport phenomena in simple liquids. A separate abstract was prepared on neutron scattering results. (M.H.R.)

For an abstract of the individual paper see: 52105.

51821 PARTICLE DYNAMICS IN STOCHASTIC ELECTROMAGNETIC FIELDS. Hall, Donald E. (Walla Walla Coll., College Place, Wash.). pp 253-69 of Plasma Instabilities in Astrophysics. Wentzel, Donat G.; Tidman, Derek A. (eds.). New York, Gordon and Breach, Science Publishers, Inc., 1969.

From International Conference on Plasma Instabilities in Astrophysics, Pacific Grove, Calif. See CONF-681042.

A rather general and abstract theory of particle behavior in stochastic electromagnetic fields is presented. Its limitations and relation to other topics in the field of plasma kinetic theory are discussed. (M.O.W.)

51822 STUDIES IN PRACTICAL PERTURBATION TECHNIQUES: THEIR DEVELOPMENT AND APPLICATION TO THE CALCULATION OF THE GROUND STATE ENERGY OF BERYLLIUM. Barr, Tery Lynn. Eugene, Oreg., Univ. of Oregon, 1968. 116p.

Thesis.

Methods were studied for making calculations on fairly complex systems, using perturbation techniques. Simple, easy to obtain zeroth order functions were used, ignoring the establishment of a Hartree–Fock (H.F.) base. Beryllium was selected as the system to be studied. First efforts were to circumvent an overcompleteness problem inherent in the basis set of a previous Brillouin–Wigner perturbation study of the Be atom. This was accomplished by expanding a trial function in terms of a complete discrete set, and using the Rayleigh–Ritz method over the hydrogenic Hamiltonian to get a new basis set. Using this set, the ground-state energy for Be was calculated through second order by both Rayleigh–Schrödinger (R.S.) and Brillouin–Wigner (B.W.) perturbation techniques. In order to solve the two-electron integrals for those terms having angular momentum, a method of Brown had to be extensively modified and programmed. A unique spectral partitioning of the Hamiltonian was developed and this led to a novel perturbation technique related to a truncated form of the Feenberg perturbation method. The total energy obtained (Calc.—14.660 a.u., obs.—14.667 a.u.) is comparable to any obtained by more difficult techniques, all of which employ a H.F. basis. (TSS) (Disser. Abstr.)

51823 ALGEBRAIC STRUCTURE OF SHELL THEORY. Wadzinski, Henry Teofil. Baltimore, Johns Hopkins Univ., 1968. 196p.

Thesis.

Given any representation of an algebra or group, it is possible to generate three representations of the same dimension from the original representation. These four representations may all be distinct, be equivalent in pairs, or all be equivalent. The possible relations between pairs of these representations are studied, obtaining the complete list of simple nonexceptional algebras in the process. The properties of general Clebsch–Gordan coefficients for semi-simple algebras are derived and a generalization of the 3-j symbols is defined. The factorization of the Clebsch–Gordan coefficients of a semi-simple algebra into a product of Clebsch–Gordan coefficients of a subalgebra and isoscalar factors is studied. The phase relations of the isoscalar factors and quantities gotten by factorizing the generalized 3-j symbols are explored using the system of phases defined for the Clebsch–Gordan coefficients. The algebraic properties of creation and annihilation operators are studied for both fermions and bosons. Different algebras are constructed from the creation and annihilation operators for a set of one-particle states, such as a shell. The types of algebras which can be constructed in this fashion are limited by the statistics of the particles and the properties of their representation of the physical algebra. Various reduction schemes are explored by which these algebras can be used to classify states and particles. The standard classification schemes of atomic shell theory are discussed. Since the isoscalar factors are largely unknown, little calculation can be carried out, but it is possible in some cases to predict when an isoscalar factor is zero. Some of the zeros in the tables of reduced matrix elements of various single-particle operators compiled by Nielson and Koster are explained in this way and null matrix elements for the magnetic spin–spin interaction between f electrons are tabulated. (TSS) (Disser. Abstr.)

51824 SIMPLE UPPER BOUND TO THE GROUND-STATE ENERGY OF A MANY-BODY SYSTEM AND CONDITION ON THE

TWO-BODY POTENTIAL NECESSARY FOR ITS STABILITY. Calogero, F. (Univ., Rome. Istituto Nazionale di Fisica Nucleare, Rome); Simonov, Yu. A. Phys. Rev., 183: 869-72(July 20, 1969).

A simple upper bound to the ground-state energy of a quantal system composed of N equal particles obeying Boltzmann or Bose statistics and interacting through the interparticle potential V(r) is established. This bound applies in the limit of large N; different expressions obtain depending on whether the potential is or is not singularly attractive at the origin. In the former case, the bound reads $-CN^{(4-q)/(2-q)}$, $-q$ being the (negative) exponent characterizing the behavior of the pair potential at the origin through $\lim_{r\to 0}[r^q V(r)] = V_0$, $-\infty < V_0 < 0$ (of course, $q < 2$ to prevent two-body collapse); in the latter case, it reads $-BN^2$. Explicit expressions for the constants C and B in terms of the pair potential V(r) are obtained; it is expected (and, in some cases, demonstrated) that the associated upper bound to the ground-state energy of the system approximates closely the actual value. It is also noted that, if for some non-negative value of p the quantity $\int_0^\infty dr\ r^2 \exp(-p^2r^2)\, V(r)$ is negative, the N-body system is unstable in the sense that, at large N, its total energy is negative and increases in modulus at least as N^2 (so that the binding energy per particle increases in modulus at least as N). Examples illustrating the nontrivial nature of this conclusion are displayed. (auth)

51825 ELEMENTARY QUANTUM MECHANICS. Scharff, Morten. New York, John Wiley and Sons, Inc., 1969. 219p. $5.95.

The physical contents of wave mechanics are presented without many of the formal aspects of the theory. The basic principles of wave mechanics, stationary states, the time-dependent behavior of particles, the particle in a central field, and systems containing several particles are covered. (J.F.P.)

51826 LOW-TEMPERATURE SPECIFIC HEAT OF AN ELECTRON GAS IN DISPLACEMENT AND COLLECTIVE VARIABLES METHOD. Bigun, M. M.; Bigun, G. I. (Lvov State Univ.). Ukr. Fiz. Zh., 14: 297-302(Feb. 1969). (In Russian).

Low-temperature specific heat of an electron gas is calculated. The expression for specific heat is obtained with the accuracy to the first order diagrams in the displacement and collective variables method. It is compared with the known results of Gell-Mann and Pines. The expression for high concentrations is shown to be a contribution of the Coulomb potential, which is cut at the distance equal to the amplitude of the plasma oscillations. (auth)

PHYSICS (HIGH ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstracts 51867–51870 and 51874.

Electromagnetic

Refer also to abstract 52089.

51827 (AD-689425) PROPERTIES AND INTERACTIONS OF NEW PARTICLES. Final Report. Pevsner, Aihud (Johns Hopkins Univ., Baltimore, Md. Dept. of Physics). May 26, 1969. 12p. (AFOSR-69-1584-TR). CFSTI.

The general objective of the research is to study the nature of fundamental particles and their production mechanisms. A counter experiment was completed relating the basic coupling constant of some of these mesons to electro-magnetic forces. In addition a search for new mesons gave a negative result for strangeness plus cne baryons, but did produce recently discovered Q and L mesons and a possible new candidate for a negative I meson. Various properties of these particles and their production mechanisms were determined. (USGRDR)

51828 (DESY-69/32) PHOTOPRODUCTION OF CHARGED PION PAIRS ON PROTONS. Alvensleben, H.; Becker, U.; Bertram, William K.; (and others) (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Sept. 1969. 12p. (In German). Dep. CFSTI (U. S. Sales Only).

A high statistics (100,000 events) measurement of photoproduction of charged pion pairs on protons is reported. First, the measured cross sections are presented in a three-dimensional data matrix where all the dynamical features are explicitly shown. Second, fitting the data in the energy region 2.6 to 6.8 GeV with various assumptions of ρ production indicates that $d\sigma/dt|_{t=0}$ for the photoproduction of ρ decreases with increasing energy similar to πN scattering. (auth)

51829 (JINR-P2-4561) EFFECT OF THE HADRON ELECTROMAGNETIC FORM FACTORS ON THE $\pi^- p \rightarrow e^+e^- n$ REACTION CROSS SECTION. Syrovtsev, Yu. S.; Tkebuchava, F. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1969. 29p. (In Russian). Dep. CFSTI (U.S. Sales Only).

A possibility of measuring the form factors of mesons and protons in the reaction $\pi^- p \rightarrow e^+e^- n$ is investigated. The general structure of the matrix element of the process is analyzed. An optimal method for the experimental data analysis is suggested. (auth)

51830 (JINR-P1-4562) EXPERIMENTAL INVESTIGATION OF THE DEVELOPMENT OF ELECTRON-PHOTON SHOWERS AT ENERGIES FROM 20 UP TO 300 MeV. Ogrzevalskii, Z.; Strugalskii, Z. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1969. 33p. (In Russian). Dep. CFSTI (U. S. Sales Only).

The experimental results concerning fluctuations of average characteristics of the longitudinal and transverse development of the electron-photon showers in the 26-litre xenon bubble chamber are given. The presented data are illustrated. (auth)

51831 (NEVIS-173) ELECTRON-POSITRON DECAY MODEL OF VECTOR MESONS. Jordan, Charles Lee (Columbia Univ., Irvington-on-Hudson, N. Y. Nevis Labs.). Apr. 1969. Contract AT(30-1)-1932. 78p. (CU-277; R-670). Dep. CFSTI.

Thesis.

At the DESY 6.2-GeV electron synchrotron, electron-positron pair yields were measured as a function of the invariant mass of the pair. The ρ and φ mesons were identified as the sources of the pairs in excess of the quantum electrodynamics pair production yield. The ω meson contributed, at most, 10% of the pairs in the invariant mass region from 660-860 MeV/c^2. The branching ratio $\Gamma(\rho \rightarrow e^+e^-)/\Gamma(\rho \rightarrow \pi^+\pi^-)$ was calculated after measuring the ρ photoproduction with the same apparatus using the process $\gamma + A \rightarrow \rho + A$, $\rho \hookrightarrow \pi^+\pi^-$. The resulting value for the branching ratio is $(6.5 \pm 1.4) \times 10^{-5}$. The measuring apparatus was a double arm symmetric magnetic spectrometer in which charged particles were detected by scintillation and Cherenkov radiation counters. The data are discussed with respect to the vector dominance model of hadronic electromagnetic interactions, muon-electron universality, and the important question of a clear determination of the width of the ρ meson. (auth)

51832 (NEVIS-174) A MEASUREMENT OF THE BRANCHING RATIO $(\eta^0 \rightarrow \pi^0\gamma\gamma)/(\eta^0 \rightarrow$ ALL NEUTRAL DECAY MODES). Shapiro, Stephen (Columbia Univ., Irvington-on-Hudson, N. Y. Nevis Labs.). May 1969. Contract AT(30-1)-1932. 95p. (CU-278; R-671). Dep. CFSTI.

Thesis.

A spark chamber experiment to measure the branching ratio $R = (\eta^0 \rightarrow \pi^0\gamma\gamma)/(\eta^0 \rightarrow$ all neutrals) was performed at the Brookhaven National Laboratory AGS. The result of this measurement is $R < 6\%$ at the 88% confidence level. Negative pions of 860 MeV/c momentum were incident on a liquid hydrogen target. The target was surrounded by scintillation counters and 4 stainless steel optical spark chambers in a nearly 4π geometry. Neutron time of flight measurements for the reaction $\pi^- + p \rightarrow X^0 + N$ enabled one to select events for which the invariant mass of the X^0 was that of the η^0. From these events, pictures having four gamma rays were selected and measured. Then each event was kinematically fitted to two hypotheses: (A) $\pi^- + p \rightarrow 2\pi^0 + N$, and (B) $\eta^0 \rightarrow \pi^0\gamma\gamma$. By normalizing the candidates for channel (B) to the candidates for channel (A), a number is obtained from which one can deduce the quantity of interest "R" in such a way as to minimize the dependence on Monte Carlo calculations of detection efficiencies. (auth)

51833 ON KNOCK-ON ELECTRONS OF COSMIC-RAY MUONS IN CONDENSED MATTER (AT 12^0 N). Bhattacharyya, D. P.; Sen Gupta, R. L. (Presidency Coll., Calcutta). Z. Phys., 227: 377-80(1969).

The dependence of knock-on electron probability on the momenta of muons producing the knock-on electrons in condensed matter was investigated by using a counter controlled cloud chamber. A search was also made on the nature of the energy spectrum of the knock-on electrons from muons in the momentum region (0.80 ± 0.05) to (1.70 ± 0.05) BeV/c. It appears from the results of the measurements that there is a very weak dependence of knock-on electron probability on the primary muon momentum in the investigated muon spectral region (i.e., (0.80 ± 0.05) to (1.70 ± 0.05) BeV/c). The angular distributions and hence the energy spectra of the emergent electrons are found to be independent of muon momentum. (auth)

51834 PHOTOPRODUCTION OF $K^+\Lambda$ AND $K^+\Sigma^0$ FROM HYDROGEN AT BACKWARD ANGLES. Anderson, R. L.; Gustavson, D.; Johnson, J.; Overman, I.; Ritson, D.; Wiik, B. H. (Stanford Linear Accelerator Center, Calif.). Phys. Rev. Lett., 23: 890-3(Oct. 13, 1969).

The photoproduction of $K^+\Lambda$ and $K^+\Sigma^0$ from hydrogen at 4.3 GeV and u values between -0.2 (GeV/c)^2 and -0.7 (GeV/c)^2 was investigated. The data were consistent with a smooth decrease in $d\sigma/du$ towards larger negative u values. The K^+ backward photoproduction cross sections appear to be closely similar to the observed cross section for backward π^+ photoproduction. The ratio of Σ^0/Λ is about 1.7, which rules out pure decuplet exchange in this region of u. The results are consistent with the SU(3) prediction. (auth)

51835 SEARCH FOR HEAVY PARTICLES AT SEA LEVEL. Gal'per, A. M.; Gomozov, V. A.; Iyudin, A. F.; Kirillov-Ugryumov, V. G.; Kotov, Yu. D.; Luchkov, B. I.; Rogovskii, A. I. (Moscow Engineering-Physics Inst.). Yadern. Fiz., 10: 336-40(Aug. 1969). (In Russian).

Results of the search for heavy nonrelativistic particles with single charge in cosmic rays are given. Measurements were performed at the sea level in the ground floor of a building with the floors of ~80 cm concrete. (auth)

51836 PHOTOPRODUCTION OF π^0 MESONS FROM ^{3}He WITH 340-MeV BREMSSTRAHLUNG. Blecher, M.; Hanson, A. O. (Univ. of Illinois, Urbana). Phys. Rev., 138: 873-9(July 20, 1969).

Differential cross sections for the coherent photoproduction of π^0 mesons from ^{3}He[^{3}He(γ,π^0)^{3}He] were measured for recoil angles of 20°, 30°, 40°, and 50° and were found to be 2–8 μb/sr, 5–25 μb/sr, 17–56 μb/sr, and 17–84 μb/sr, respectively. A gaseous ^{3}He target at 20.4°K was irradiated by 340-MeV bremsstrahlung, and ^{3}He recoils were observed with silicon semiconductor detectors. At least one γ ray from the pion decay was detected with a photon shower counter. A coincidence triggered an oscilloscope on which all pulses were displayed and photographed. The experimental cross sections are compared with those obtained by various impulse-approximation calculations. Although the calculations depend on the manner of specifying the energy and momentum dependence of

the photon-nucleon amplitudes in the ^{3}He nucleus, a calculation assuming that the three nucleons were initially at rest accounts for most of the measurements. (auth)

51837 OBSERVED BEHAVIOR OF HIGHLY INELASTIC ELECTRON–PROTON SCATTERING. Breidenbach, M. (Massachusetts Inst. of Tech., Cambridge); Friedman, J. I.; Kendall, H. W.; Bloom, E. D.; Coward, D. H.; DeStaebler, H.; Drees, J.; Mo, L. W.; Taylor, R. E. Contract AT(30-1)-2098. Phys. Rev. Lett., 23: 935-9(Oct. 20, 1969).

Results of electron–proton inelastic scattering at 6 and 10° are discussed, and values of the structure function W_2 are estimated. If the interaction is dominated by transverse virtual photons, νW_2 can be expressed as a function of $\omega = 2M\nu/q^2$ within experimental errors for $q^2 > 1$ (GeV/c)^2 and $\omega > 4$, where ν is the invariant energy transfer and q^2 is the invariant momentum transfer of the electron. Various theoretical models and sum rules are briefly discussed. (auth)

51838 HIGH-ENERGY INELASTIC e–p SCATTERING AT 6° AND 10°. Bloom, E. D. (Stanford Linear Accelerator Center, Calif.); Coward, D. H.; DeStaebler, H.; (and others). Phys. Rev. Lett., 23: 930-4(Oct. 20, 1969).

Cross sections for inelastic scattering of electrons from hydrogen were measured for incident energies from 7 to 17 GeV at scattering angles of 6 to 10° covering a range of squared four-momentum transfers up to 7.4 (GeV/c)^2. For low center-of-mass energies of the final hadronic system the cross section shows prominent resonances at low momentum transfer and diminishes markedly at higher momentum transfer. For high excitations the cross section shows only a weak momentum-transfer dependence. (auth)

51839 EXPERIMENTAL TEST OF QUANTUM ELECTRODYNAMICS BY PHOTOPRODUCTION OF WIDE-ANGLE ELECTRON PAIRS FROM HYDROGEN. Biggs, P. J.; Braben, D. W.; Clifft, R. W.; Gabathuler, E.; Kitching, P.; Rand, R. E. (Nuclear Physics Lab., Daresbury, Eng.). Phys. Rev. Lett., 23: 927-30 (Oct. 20, 1969).

The photoproduction of wide-angle electron pairs from hydrogen and carbon was measured as a test of quantum electrodynamics (QED), using the 5-GeV electron synchrotron NINA. The results are consistent with the predictions of QED up to an invariant mass of the electron–positron pair of 500 MeV/c^2. (auth)

Weak

51840 (CEA-R-3813) STUDY OF THE FORM FACTORS OF THE LEPTONIC DECAYS OF THE K^0_L. Zylberajch, Sylvain (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). July 1969. 158p. (In French). Dep. CFSTI (U. S. Sales Only).

Thesis. Submitted to Univ. of Paris, Orsay, France.

About 24,000 K^0_L decays were observed in a spark chamber spectrometer. There were 11,000 K_{e3} and 7,000 $K_{\mu 3}$ decays identified and their distribution in the Dalitz plot analyzed. In the study of the $K_{\mu 3}$ mode $K^0_L \to \pi^\pm \mu^\mp \nu$ the interaction is found to be essentially a vectorial one. For the ratio $\xi = f_-/f_+$ a double solution is found: $\xi = -3.9 \pm 0.18$, $\xi = 1.5 \pm 0.18$ the first solution is more likely. The study of the K_{e3} mode $K^0_L \to \pi^\pm e^\mp \nu$ also confirms the vectorial nature of the interaction. It is found that: $|A_S/A_V| \leq 11\%$ and $|A_T/A_V| \leq 6\%$. The q^2 dependence of the form factor f_+ is weak: $\lambda_+ = 0.023 \pm 0.012$. (auth)

51841 (NEVIS-172) NEUTRON EMISSION FROM MUON CAPTURE. Krieger, Martin H. (Columbia Univ., Irvington-on-Hudson, N. Y. Nevis Labs.). Apr. 1969. Contract AT(30-1)-1932. 82p. (CU-276; R-669). Dep. CFSTI.

Thesis.

A high-resolution measurement of the neutron energy spectrum from muon capture in calcium, sulfur and lead was performed. A unique spark chamber-scintillator neutron detector was used which gives a direct measurement of the neutron energy. The energy spectra fall off approximately exponentially between 10 and 40 MeV. The adequacy of current nuclear models for explaining these results is explored. (auth)

51842 (NEVIS-175) SIGMA LEPTONIC BRANCHING RATIOS. Norton, Herbert (Columbia Univ., Irvington-on-Hudson, N. Y. Nevis Labs.). May 1969. Contract AT(30-1)-1932. 70p. (CU-279; R-672). Dep. CFSTI.

Thesis.

An exposure of 550,000 pictures of K^-, stopping in hydrogen, was scanned for obvious Σ leptonic decays. The film contained 2.1×10^6 Σ^-'s and 1.0×10^6 Σ^+'s produced by the reactions $K^-p \to \Sigma^\pm \pi^\mp$. The results are as follows:

Decay	Number of Events Accepted	Branching Ratios
$\Sigma^- \to \Lambda^0 e^- \nu$	29	$(5.2 \pm 1.0) \times 10^{-5}$
$\Sigma^+ \to \Lambda^0 e^+ \nu$	5	$(1.7 \pm 0.8) \times 10^{-5}$
$\Sigma^- \to n e^- \nu$	58	$(0.97 \pm 0.13) \times 10^{-3}$
$\Sigma^- \to n \mu^- \nu$	13	$(0.38 \pm 0.13) \times 10^{-3}$
$\Sigma^+ \to n e^+ \nu$	2	$\Gamma(\Sigma^+ \to n l^+ \nu) \leq 8\%$ (90% confidence)
$\Sigma^+ \to n \mu^+ \nu$	0	$\Gamma(\Sigma^- \to n l^- \nu)$

These ratios agree within errors with the ratios measured by other groups. Averaging the data with the world data and using some other measurements, a fit is obtained to Cabibbo theory with a χ^2 of 4.59 for 8 degrees of freedom with $\theta = \theta_A = \theta_V = 0.232$, F = 0.46, D = 0.74. (auth)

51843 (UCRL-19244) NONLEPTONIC DECAY OF SIGMA HYPERONS. Bangerter, Roger Odell (California Univ., Berkeley. Lawrence Radiation Lab.). July 7, 1969. Contract W-7405-eng-48. 96p. Dep. CFSTI.

Measurements of the decay parameters α_-, α_0 and α_+ for $\Sigma^- \to n\pi^-$, $\Sigma^+ \to p\pi^0$, and $\Sigma^+ \to n\pi^+$ are presented. Also the decay parameters Φ_- and Φ_+ were measured for $\Sigma^- \to n\pi^-$ and $\Sigma^+ \to n\pi^+$. The usual decay parameters α, β, and γ are related to Φ by the equations $\beta = (1-\alpha^2)^{1/2} \sin\Phi$ and $\gamma = (1-\alpha^2)^{1/2} \cos\Phi$. Polarized $\Sigma^\pm$ are produced by the reaction $K^-p \to \Sigma^\pm \pi^\mp$ in the Lawrence Radiation Laboratory's 25-inch hydrogen bubble chamber. The average momentum of the incident K^- beam is 385 MeV/c. The measurements of α are performed by observing the up-down asymmetry in the Σ decay distributions and the measurements of Φ are made by observing the left-right asymmetry in the np interactions of those decay neutrons that subsequently scattered on the hydrogen in the bubble chamber. The parameters $\alpha_- = -0.071 \pm 0.012$, $\alpha_0 = -0.999 \pm 0.022$, $\alpha_+/\alpha_0 = -0.062 \pm 0.016$, $\Phi_- = 14 \pm 19$ deg, and $\Phi_+ = 143 \pm 29$ deg were obtained. These results are in agreement with the $|\Delta I| = 1/2$ rule. (auth)

51844 RADIATIVE $\Sigma^\pm$ DECAYS AND SEARCH FOR NEUTRAL CURRENTS. Ang, G.; Ebenhoeh, H.; Eisele, F.; (and others) (Univ., Heidelberg). Z. Phys., 228: 151-62(1969).

The decay modes $\Sigma^\pm \to n\pi^\pm\gamma$, $\Sigma^+ \to p\gamma$, and $\Sigma^+ \to pe^+c^-$ were studied in the 81 cm Saclay hydrogen bubble chamber. In the radiative decay $\Sigma^\pm \to n\pi^\pm\gamma$ only low momentum pions (< 110 MeV/c) which stop in the chamber were accepted. The $\Sigma^\pm \to n\pi^\pm\gamma$ branching ratios were found to agree well with theoretical calculations and confirmed very strongly the assignment S wave to $\Sigma^- \to n\pi^-$ and P wave to $\Sigma^+ \to n\pi^+$ decay. A comparison of the $\Sigma^+ \to p\gamma$ and the $\Sigma^+ \to p + e^+ + e^-$ rates yielded for the conversion coefficient $\rho \sim 1/140$, in agreement with predictions from electrodynamics. Neutral current contributions in leptonic Σ decays were found to be at most of the order of 1%. (L.B.S.)

Strong (Baryon-Induced)

51845 (CEA-CONF-1406) MEASUREMENT OF THE CROSS SECTION OF d,p ELASTIC SCATTERING AT 180 AND 174.5° IN THE c.m. SYSTEM WITH INCIDENT DEUTERONS AT 3.78 GeV/c. Banaigs, J.; Berger, J.; Duflo, J.; Goldzahl, L. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires); Cottereau, M.; Lefebvres, F. (Caen Univ. (France). Laboratoire de Physique Corpusculaire). [1967]. 12p. (In French). (CONF-690608-10). Dep. CFSTI (U. S. Sales Only).

From International Conference on Elementary Particles, Lund, Sweden.

The elastic differential cross section for dp scattering at 180 and 174.5° in the center of mass system is measured for incident deuterons of 3.78 GeV/c. The value found at 180° is 12 ± 2.4 μb/sp. In the angular region studied a maximum is observed in the cross section near 177°. A comparison is made with recent theoretical results. (tr-auth)

51846 (CEA-CONF-1407) STUDY OF THE REACTION d + d → ^{4}He + (MM)^0 AT 180° IN THE c.m. SYSTEM FOR AN INCIDENT MOMENTUM OF 3.78 GeV/c. Banaigs, J.; Berger, J.; Duflo, J.; Goldzahl, L. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires); Cottereau, M.; Lefebvres, F. (Caen Univ. (France). Laboratoire de Physique Corpusculaire). [1966]. 12p. (In French). (CONF-690608-11). Dep. CFSTI (U. S. Sales Only).

From International Conference on Elementary Particles, Lund, Sweden.

The differential cross section for ^{4}He production in the reaction d + d → ^{4}He + (MM)^0 at 180° in the center of mass system, for incident deuterons of 3.78 GeV/c is measured. Outside of a continuum the production of ω^0 is observed with a cross section in the neighborhood of 5 mμb/sr. (tr-auth)

51847 (CEA-CONF-1408) OBSERVATION OF MESON STRUCTURES OF MASSES 300 AND 450 MeV. Banaigs, J.; Berger, J.; Duflo, J.; Goldzahl, L. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires); Cottereau, M.; Lefebvres, F. (Caen Univ. (France). Laboratoire de Physique Corpusculaire). [1964]. 27p. (In French). (CONF-690608-12). Dep. CFSTI (U. S. Sales Only).

From International Conference on Elementary Particles, Lund, Sweden.

The general effect of the experimental results from two different reactions: $d + p \rightarrow {}^3He + (MM)^0$ at 3.22, 3.42, 3.56, and 3.78 GeV/c and $d + p \rightarrow d + (MM)^+$ at 3.22, 3.56, and 3.78 GeV/c interpreted in the impulse approximation as the reaction $n + p \rightarrow d + (MM)^0$ at half momentum, confirms the existence of an important meson structure of mass 300 ± 10 MeV. Furthermore, for all the momenta of the reaction in ^3He a meson structure of mass 450 ± 10 MeV was observed. (tr-auth)

51848 (COO-2009-4) TECHNICAL PROGRESS REPORT OF THE INDIANA UNIVERSITY SPARK CHAMBER GROUP, DECEMBER 1, 1968–NOVEMBER 30, 1969. (Indiana Univ., Bloomington). Contract AT(11-1)-2009. 16p. Dep. CFSTI.

A review of experiments planned and in progress by the spark chamber group on $\pi + p$ and $p + p$ interactions during this period is reported. A list of articles published during this period is also included. (J.F.P.)

51849 (IFVE-SEF-69-18) THE FORMATION OF NEGATIVE PARTICLES BY PROTONS WITH ENERGIES UP TO 70 GeV. Bushnin, Yu. B.; Gorin, Yu. P.; Denisov, S. P.; (and others) (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1969. 16p. (In Russian). Dep. CFSTI (U. S. Sales Only).

The first experimental results are presented for forward angle production (<15 mRad) of $\pi^-, K^-, \bar{p}$ by protons with energies up to 70 GeV. The target material was aluminium and the secondary momenta investigated were greater than 0.5 Po, where Po was the momentum of the accelerated protons. Upper limits are presented for the production of antideuterons and new, long-lived particles with masses below 2.2 GeV. High-resolution gas Cherenkov counters were used for the identification of the particles. (auth)

51850 (NYO-1932(2)-148) SEARCH FOR UNCHARGED FASTER THAN LIGHT PARTICLES. Baltay, C.; Feinberg, G.; Yeh, N. (Columbia Univ., New York); Linsker, R. (National Aeronautics and Space Administration, New York. Goddard Inst. for Space Studies). [1969]. 41p. Dep. CFSTI.

An experiment was carried out to search for uncharged particles with spacelike four momentum which presumably travel faster than light. No evidence for such particles was found. The results can be expressed as upper limits on the production rates for such particles by stopped K^- and $\bar{p}$ compared to production rates of pions in similar reactions. Other sources of information placing limits on the interactions of tachyons are discussed. (auth)

51851 HIGH-PRECISION MEASUREMENT OF THE TOTAL n–p SCATTERING CROSS SECTION IN THE ENERGY RANGE 0.7–32 MeV. Cierjacks, S.; Forti, P.; Kirouac, G. J.; Kopsch, D.; Kropp, L.; Nebe, J. (Kernforschungszentrum, Karlsruhe, Ger.). Phys. Rev. Lett., 23: 866-8(Oct. 13, 1969).

The total n-p cross section was measured using the neutron time-of-flight spectrometer at the Karlsruhe isochronous cyclotron. The measurements span the energy range from 0.7 to 32 MeV with statistical accuracy which varies from 0.2 to 1.0% and an energy resolution of 0.7 keV at 0.7 MeV and 200 keV at 30 MeV. No evidence was found for the recently reported oscillations in the total n-p scattering cross section. (auth)

51852 $n + p \rightarrow d + \gamma$ AND TIME-REVERSAL INVARIANCE. Bartlett, D. F. (Palmer Physical Lab., Princeton, N. J.); Friedberg, C. E.; Goulianos, K.; Hammerman, I. S.; Hutchinson, D. P. Contract AT(30-1)-2137. Phys. Rev. Lett., 23: 893-7(Oct. 13, 1969).

Measurements are reported of the differential and total cross section for $n + p \rightarrow d + \gamma$ for neutron energies between 160 and 640 MeV. A comparison is made with the differential and total cross sections for the inverse process. (auth)

51853 AN ANALYSIS OF CENTRAL NUCLEUS–NUCLEUS COLLISIONS AT THE ENERGY EXCEEDING 1 TeV/NUCLEON. Rybicki, K. (Inst. for Nuclear Research, Krakow). Acta Phys. Pol., 36: No. 1, 69-81(July 1969).

The central collisions of cosmic nuclei with nuclei of photographic emulsion is considered. On the basis of 36 interactions of energy per nucleon exceeding 0.1 TeV it was found that events with $N_h < 5$ and $N_h > 10$ (no intermediate N_h-values were observed) correspond to collisions with light (H, C, N, O and heavy (Ag, Br)) emulsion nuclei, respectively. It was also found that the Castagnoli formula is a reliable energy estimate for central nucleus–nucleus collisions at the energy higher than 0.1 TeV/nucleon. There were 13 central nucleus–nucleus collisions of energy per nucleon exceeding 1 TeV measured. It was found that in collisions with light target nuclei the quantity $(n_s - Z/A) = 6.0 \pm 0.9$ and only a fraction of incident nucleons interacts, while in collisions with heavy target nuclei $(n_s - Z/A) = 19.2 \pm 8.4$ and practically all incident nucleons interact. Among highest-energy secondaries the neutral-to-charged ratio is 15 : 14 which means that nucleons are leading particles. These nucleons carry away on the average (50 to 60)% of primary energy. There is an indication that their transverse momenta exceed 0.4 GeV/c especially in collisions with light target nuclei. The characteristics of angular distribution of secondary particles are similar to those in nucleon-induced jets. In general the central nucleus–nucleon collisions are well described by the superposition of nucleon–nucleon collisions. (auth)

51854 SEARCH FOR QUARKS ON 70 GeV ACCELERATOR OF THE INSTITUTE OF HIGH ENERGY PHYSICS. Antipov, Yu. M.; Vishnevskii, N. K.; Ech, F. A.; (and others). (Inst. of High-Energy Physics, Serpukhov, USSR). Yadern. Fiz., 10: 346-53(Aug. 1969). (In Russian).

Results of experiments on the search for quarks with charge from $\frac{2}{3}e$ up to $\frac{1}{3}e$ produced by 70-GeV protons on an aluminum target at zero angle are presented. In the region of masses which can be obtained from the accelerators of the Institution of High Energy Physics quarks were not detected. The upper limiting estimate of the differential cross section for production of quarks with the mass ≤ 5 GeV/c^2 and with charge $\frac{2}{3}e$, was found to be (7 to 9) 10^{-36} cm^2/sterad · (GeV/c) (with 90% confidence). The total cross section of production of quarks with charge $\frac{2}{3}e$ and with mass 4.5 to 5 GeV/c^2 does not exceed 4 (10^{-37}) cm^2. (auth)

Strong (Meson-Induced)

51855 (CEA-R-3544) STUDY OF THE REACTION $\pi^-p \rightarrow \pi^+\pi^-n$ AT 870 MeV. Zsembery, Janos (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). July 1969. 61p. (In French). Dep. CFSTI (U. S. Sales Only).

Thesis. Submitted to Catholic Univ. of Louvain, Belgium.

In the reaction $\pi^-p \rightarrow \pi^+\pi^-n$, the π^+ momentum spectrum was measured at various angles, from which the distributions $(d^2\sigma/dMd\Omega)^*$ of the (π^-n) system were deduced. These distributions are compared with those obtained by a phenomenological model. This comparison allows a determination of the amplitude of the inelastic waves. It is found that the resonant waves D15 and F15 are not strongly coupled to the channel $\Delta(1238) + \pi$. (auth)

51856 (CERN-69-24) EXPERIMENTAL STUDY OF THE PRODUCTION OF CHARGED PIONS IN THE COLLISIONS PROTONS-CORE AT 600 MeV. Hirt, W.; Heer, E.; Martin, M.; Michaelis, E. G.; Serre, C.; Skarek, P.; Wright, B. T. (European Organization for Nuclear Research, Geneva (Switzerland)). Sept. 5, 1969. 90p. (In French). Dep. CFSTI (U. S. Sales Only).

The production of charged pions by 600 MeV protons on nuclei was studied. A detailed description of the experimental procedure is given. The measured differential production cross sections for Be, C, Al, Cu, Ag, Pb, CH_2 and CD_2 at pion energies between 50 and 350 MeV, for production angles of 0.8 and 21.5° are presented. A comparison with other results, and a theoretical investigation of the data are made. (auth)

51857 (INR-1100) ANNUAL REPORT, INSTITUTE OF NUCLEAR RESEARCH, YEAR 1968. (Institute of Nuclear Research, Warsaw (Poland)). 1969. 207p. (In Polish). Dep. CFSTI (U. S. Sales Only).

A brief review is given of research in the fields of nuclear physics, including nuclear reactions, nuclear spectroscopy, high energy physics, plasma physics, and nuclear electronics. Research programs in nuclear chemistry, radiobiology, reactor technology, isotope technology, and high-temperature technology including MHD generators are also outlined. Lists of publications during the year are included after each section. (C.E.S.)

51858 (NEVIS-171) π^+p INTERACTION AT 8.5 GeV/c. Kung, Huai Han (Columbia Univ., Irvington-on-Hudson, N. Y. Nevis Labs.). Apr. 1969. Contract AT(30-1)-1932. 89p. (CU-275; R-667). Dep. CFSTI.

Thesis.

A total of 60,000 pictures, with incident π^+ at the momentum of 8.49 GeV/c, were obtained from the Brookhaven National Laboratory 80-in. hydrogen bubble chamber. The study pertains to resonance production in the proton multipion final states. A total of 18,000 4-prong events, 6,500 6-prong events, and 500 8-prong

events were measured and fitted to proton plus n-pion final states, n ranging from 3 to 8. The information obtained shows strong production of $N^{*++}(1235)$ and other pionic resonances such as ρ^0, ω^0, η^0, f^0 in the 4- and 5-body final states, and that such reactions were essentially peripheral, i.e., with very low Δ^2 (defined as the negative of the 4-momenta transfer square to the proton). The cross sections for various channels are given and fraction of resonance productions, notably N^{*++}, ρ^0, ω^0, etc. are also included. The observation of A_2^0 in the channel $\pi^+ + p \rightarrow N^{*++} + A_2^0 \rightarrow \pi^+ + p + \pi^+ + \pi^- + \pi^0$ is discussed in some detail. Two other resonances, one at ~1630 MeV in the 3π system from the 4-body final state and one at ~1720 MeV in the 4π system from the 5-body final state have been observed. These states are found to decay, among other modes into $f^0\pi$ and $\omega^0\pi$ for the 1630 MeV and the 1720 MeV states, respectively, indicating that both have isotopic spin equal to 1. (auth)

51859 (UCRL-19251) KAON MASS MEASUREMENT FROM KAONIC ATOM X RAYS. Kunselman, Raymond; Wiegand, Clyde E. (California Univ., Berkeley. Lawrence Radiation Lab.). July 1969. Contract W-7405-eng-48. 8p. (CONF-690503-6). Dep. CFSTI.

From International Conference on Hypernuclear Physics, Argonne, Ill.

Measurements on several x-ray transitions of kaonic atoms are presented. Preliminary results of a determination of the mass of mesons (K^-) from the difference in energy between two atomic energy levels are given. The data are taken from previous work. The measured values of the meson (K^-) mass are listed and plotted, and the weighted average is found to be 493.97 ± 0.22 MeV. It is noted that this method is not statistically as accurate as the emulsion method, but it can be improved. (J.F.P.)

51860 (UCRL-19275) A STUDY OF THE REACTION $\pi^+d \rightarrow (p)\, p\, \pi^+\pi^-\pi^0$ AT INCIDENT PION MOMENTA BETWEEN 1.1 AND 2.4 GeV/c. Danburg, Jerome Samuel (California Univ., Berkeley. Lawrence Radiation Lab.). July 1969. Contract W-7405-eng-48. 167p. Dep. CFSTI.

Thesis.

The reaction $\pi^+d \rightarrow (p)\, p\, \pi^+\pi^-\pi^0$ was studied in a 264,000-picture bubble chamber experiment with pion beam momentum between 1.1 and 2.4 BeV/c. The most significant features of the final state are production of η and ω mesons in the reactions $\pi^+ n \rightarrow \eta p$, and $\pi^+ n \rightarrow \omega p$. The η production characteristics are well described by a Reggeized A_2-exchange model using Veneziano-type residue functions. The ω production and decay characteristics are presented, and it is found that a ρ-exchange model with absorptive corrections is inadequate to describe the data. (auth)

51861 (UCRL-19278) POLARIZATION IN K^+p ELASTIC SCATTERING AT 864 MeV/c. Hauptman, John M.; Bland, Roger W. (California Univ., Berkeley. Lawrence Radiation Lab.). Aug. 1969. Contract W-7405-eng-48. 3p. Dep. CFSTI.

A rough measurement of the proton polarization in K^+p elastic scattering at 864 MeV/c was made in a hydrogen bubble chamber. It is found that the polarization can be represented as $P(\theta) = (0.9 \pm 0.5) \sin\theta$, where θ is the c.m. scattering angle between the incident and the outgoing kaon. (auth)

51862 Ξ RESONANCES IN $K^-p \rightarrow \Xi\pi K$ AT 2.87 GeV/c. Apsell, S. (Brandeis Univ., Waltham, Mass.); Barash-Schmidt, N.; Kirsch, L.; (and others). Phys. Rev. Lett., 23: 884-6(Oct. 13, 1969).

Evidence is presented for four Ξ resonances in the reaction $K^-p \rightarrow \Xi^-\pi^+K^0$. In addition to the well known Ξ(1530), significant structures are observed in the $\Xi\pi$ system at masses of 1630, 1800, and 1960 MeV, although the latter two are not statistically distinguishable from a single broad structure at 1950 MeV. No significant enhancements at these masses are observed in the $\Xi^-\pi^0K^+$ final state. (auth)

51863 K^-p BACKWARD SCATTERING FROM 1 TO 2.5 GeV/c. Carroll, A. S. (Brookhaven National Lab., Upton, N. Y.); Fischer, J.; Lundby, A.; Phillips, R. H.; Wang, C. L.; Lobkowicz, F. Melissinos, A. C.; Nagashima, Y.; Smith, C. A.; Tewksbury, S. Phys. Rev. Lett., 23: 887-90(Oct. 13, 1969).

Elastic scattering of K^- mesons from protons in the backward direction was measured to high accuracy in the momentum interval from 1.0 to 2.5 GeV/c. The cross sections exhibit a very fast decrease as a function of energy given by $d\sigma/du \sim s^{-10}$. The data can be fitted either by a superposition of the known resonant amplitudes in the K^-p system, or by postulating the existence of a Z* Regge trajectory. (auth)

51864 A_3^+ PRODUCTION IN π + d INTERACTIONS AT 5.1 GeV/c. Armenise, N. (Univ., Bari, Italy. Istituto Nazionale di Fisica Nucleare, Bari, Italy); Ghidini, B.; Picciarelli, V.; (and others). Nuovo Cim., Lett., 2: 501-9(Oct. 1, 1969).

An analysis of the A_3 resonance in the three-pion mass distribution for the interaction $\pi^+ + d \rightarrow n + p + 2\pi^+ + \pi^-$ at 5.1 GeV/c in a deuterium bubble chamber is presented. Also an experimental cut at 1.3 GeV/c was done on the proton momentum in order to identify the particle by ionization. Other resonances present are the A_2, the φ and the f. The branching ratio for $A_3 \rightarrow f + \pi$ decay, the value 1.673 GeV for the mass, and a width of 0.24 GeV are given. (J.F.P.)

51865 COHERENT PRODUCTION OF PIONS IN HIGH ENERGY π^--INTERACTIONS. Kamal, A. A.; Rao, Y. V.; Rao, Rukmini (Osmania Univ., Hyderabad, India). Proc. Indian Acad. Sci., Sect. A, 69: 218-27(Apr. 1969).

From an analysis of 12 pion tridents produced in 17.2 GeV/c π^--interactions in emulsion nuclei, the distributions of the longitudinal and transverse momentum of recoil nuclei are obtained. The distribution of transverse momentum of recoil nuclei for the combined data of Caforio et al., Azimov et al., and the present experiment is compared with the expected curves for various assumptions. It is demonstrated that the best fit is for the assumptions (a) only light nuclei contribute to the coherent process and (b) all nuclei contribute equally. It is stressed that the conclusion of Caforio et al., that the light nuclei do not play an important role is based on the discrepancy between the observed and expected mean free path which is critically hinged on the cross-section obtained in the heavy liquid bubble chamber — a cross-section whose value is uncertain. (auth)

Particle Interactions and Properties (Theoretical)

General

Refer also to abstracts 51825, 52004, and 52011.

51866 (ITF-69-48) CERTAIN TYPE OF REPRESENTATIONS OF CURRENT ALGEBRA. Klimyk, A. U. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1969. 19p. Dep. CFSTI (U. S. Sales Only).

The linear representations of the current commutation relations by bounded operators in the direct integral of Hilbert spaces and an invariance of such representations with respect to the group are considered. (J.F.P.)

51867 (NYO-1984-13) HIGH ENERGY PHYSICS. Progress Report. (Tufts Univ., Medford, Mass.). Sept. 1969. Contract AT(30-1)-1984. 22p. Dep. CFSTI.

Brief summaries of experimental work on high-energy interactions completed or in progress are given. Also proposed experiments are described. The equipment and technical progress are discussed. (J.F.P.)

51868 (UCRL-18877) PHYSICS SEMIANNUAL REPORT, NOVEMBER 1968-APRIL 1969. (California Univ., Berkeley. Lawrence Radiation Lab.). May 1969. 166p. Dep. CFSTI.

A report on experimental and theoretical high-energy physics at the Lawrence Radiation Laboratory is given. Also nuclear physics, plasma physics, atomic physics, accelerator theory, health physics, mathematics and computing, and accelerator operation and development are covered. The period from November, 1968, to April, 1969, is covered. (J.F.P.)

51869 HIGH ENERGY PHYSICS INDEX. VOLUME 7, NO. 16, 1969. Frankfurt am Main, Zentralstelle fuer Atomkernenergie-Dokumentation, 1969. 80p.

51870 HIGH ENERGY PHYSICS INDEX. VOLUME 7, NO. 17, 1969. Frankfurt am Main, Zentralstelle fuer Atomkernenergie-Dokumentation, 1969. 71p.

51871 STRUCTURE OF ELEMENTARY PARTICLES. Bartke, Jerzy (Inst. for Nuclear Research, Krakow). Postepy Fiz., 20: 423-40(1969). (In Polish).

Present knowledge of the structure of elementary particles is reviewed. The experimental situation concerning the electromagnetic structure of nucleons and pions is discussed in detail and the relevant theoretical questions are also briefly presented. Finally, some recent ideas are mentioned which connect the particle internal structure to high energy scattering. (auth)

51872 WIENER-HOPF METHOD AND GENERALIZED INTEGRAL TRANSFORMS. Bassetto, A.; Paccanoni, F. (Univ.,

Padua. Istituto Nazionale di Fisica Nucleare, Padua). J. Math. Phys. (N. Y.), 10: 1809-12(Sept. 1969).

A class of singular integral equations that can be solved by means of the Wiener–Hopf technique is considered. The resolvent is given as a dispersion relation in the plane of the parameter λ, and some physical applications are discussed. (auth)

51873 GENERALITIES ON THE PHYSICS OF ELEMENTARY PARTICLES. Beckers, J. (Univ., Liege). Rev. Quest. Sci., 140: 319-31(July 1969). (In French).

The current status of elementary particles is reviewed. Problems in definition of an elementary particle are noted, beginning with empirical problems of physics experiments, and reaching into philosophical problems of the nature of experiments. Attempts to classify the known particles are examined. One classification generally adopted is mass; thus one has photons, leptons, mesons, baryons. Classification by internal properties (leptonic or baryonic number, strangeness, hypercharge) is reviewed. Generalization of the properties of hadrons and leptons leads to considerations of all interactions: gravitational, weak, electromagnetic, nuclear. The progress in the field is summarized in the theory of dispersion relations, axiomatics of the quantum theory of fields, study of compact groups and non-compact groups, the study of violations of fundamental invariances, the study of the algebras of currents, fields, and effective Lagrangians, and the study of phenomenological models. (BBB)

51874 LA MATIERE–ENERGIE DANS SES PARTICULES ULTIMES. (Matter–Energy in the Ultimate Particles). Debiesse, J.; Lemoigne, L. Monographies Dunod, No. 73. Paris, Dunod, 1969. 135p.

A theoretical and experimental review of elementary particle physics is presented. Experimental techniques and several typical experiments are described, and symmetries and conservation laws are discussed. The topics covered include projectile sources, targets and analysis apparatus, the means of detection and registration, interactions in general, nomenclature and classification, and particle quantum numbers. (J.F.P.)

51875 MODERN QUANTUM MECHANICS WITH APPLICATIONS TO ELEMENTARY PARTICLE PHYSICS. A INTRODUCTION TO CONTEMPORARY PHYSICAL THINKING. Eisele, John A. New York, John Wiley and Sons, Inc., 1969. 551p. $19.95.

The discussion covers the basic electromagnetic theory and nonrelativistic quantum mechanics, the Schroedinger–Fock–Klein–Gordon equation, the Dirac equation, Feynman methods in quantum electrodynamics, the Foldy–Wouthuysen method, elements of the Fermi theory of beta decay, nonconservation of parity, and isotopic spin and nucleon isobar models. (J.F.P.)

Electromagnetic

Refer also to abstracts 51829, 51952, 51987, 51989, 51993, and 51994.

51876 (DESY–69/21) ELECTROMAGNETIC INTERACTIONS. Lohrmann, E. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). July 1969. 101p. (CONF-690608–9). Dep. CFSTI (U. S. Sales Only).

From International Conference on Elementary Particles, Lund, Sweden.

A review of electromagnetic interactions covering the status of quantum electrodynamics and electron–muon universality, photoproduction, and elastic and inelastic electron–nucleon scattering is presented. (J.F.P.)

51877 (DESY–69/30) INCOHERENT PRODUCTION OF ρ^0-MESONS FROM NUCLEI AND VECTOR DOMINANCE. von Bochmann, G.; Margolis, B. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Aug. 1969. 8p. Dep. CFSTI (U. S. Sales Only).

Incoherent photoproduction of ρ^0-mesons on the nucleus is calculated assuming vector dominance. The results are sensitive to the ρ-nucleon total cross section which is found to be decreasing with energy. One finds a relatively weak dependence on energy of the incoherent effective number. (auth)

51878 (DESY–69/31) PERIPHERAL MODEL PREDICTIONS FOR π^0 AND η^0 PHOTOPRODUCTION. Dar, A.; Watts, T. L.; Weisskopf, V. F. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Aug. 1969. 11p. Dep. CFSTI (U. S. Sales Only).

Cross sections for photoproduction of π^0 and η^0 from nucleons with unpolarized and polarized photon beams were calculated using a new peripheral model for high-energy exchange reactions. The predictions are in good agreement with available data from CEA, DESY and SLAC on photoproduction from protons. Predictions for π^0 photoproduction from neutrons are also presented. (auth)

51879 (DESY–69/33) ELECTROPRODUCTION OF N* (1236) IN THE RESONANCE REGION. [PART] II. Gutbrod, Fritz (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Sept. 1969. 30p. (In German). Dep. CFSTI (U. S. Sales Only).

Ladder diagrams containing nucleon exchange for πN-scattering and for pion electroproduction in the N*(1236) channel were calculated in the resonance region. Using the technique of Padè approximants, scattering and electroproduction amplitudes are constructed from the perturbation series, which converge well with increasing order of the Padè approximants. Two different cut-off procedures for the exchanged nucleon are investigated, as well as inelastic corrections in the direct channel, and the cut-off parameters are adjusted to give the correct scattering phase shift at the resonance position. With the N*-Bethe–Salpeter wave function determined by the nucleon exchange potential and its cut-off parameters, photo- and electroexcitation amplitudes of the resonance are calculated, assuming single nucleon and pion exchange γNN*-transition potentials. The dependence of the normalization of the photoproduction amplitudes on the cut-off parameters in the transition potential is only weak, and the momentum transfer dependence of the multipoles is almost independent of the details of the transition potential. (auth)

51880 (JINR–P2-4644) PHOTOPRODUCTION OF LEPTON PAIRS ON ELECTRONS. Bardin, D. Yu.; Boehm, J.; Semikoz, V. B.; Fakirov, D.; Shumeiko, N. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1969. 12p. (In Russian). Dep. CFSTI (U. S. Sales Only).

The cross sections for the processes $\gamma e \rightarrow e l^+ l^-$ were calculated without taking into account the exchange diagrams. (auth)

51881 (ORNL-tr–1908) MONTE CARLO CALCULATIONS FOR 3-GeV SHOWERS IN LEAD. Burfeindt, H. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Translated for Oak Ridge National Lab., Tenn., from report DESY–67/24. 19p. Dep. CFSTI.

Electron–photon cascades in lead for 3-GeV electrons as the primary particles were calculated with a Monte Carlo program. The result of the calculation is expressed in the form of energy, longitudinal, radial, and angular distributions. (auth)

51882 (ORNL-tr–2208) EMPIRICAL PATHLENGTH-ENERGY RELATIONSHIP FOR PROTONS WITH ENERGIES OF 100 TO 100,000 MeV. Vzorov, I. K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). Translated for Oak Ridge National Lab., Tenn., from report JINR–P1-4442. 5p. Dep. CFSTI.

Relations between the pathlength and the energy of particles are presented and are of the form $R = a(\ln T)^b$ and $T = (c)^{R^{1/b}}$ (where R is expressed in g/cm^2 and T is expressed in MeV, and a, b, and c are parameters depending on the atomic number of the moderator). For protons the use of these relations makes it possible to approximate the data of a path–energy table calculated for the most frequently encountered materials at an energy range of 100 to 100,000 MeV. Values for the pathlengths of fast protons can be used to determine the pathlengths of other particles by means of a given relation. For mesons (μ) the range of applicability of the relations is 10 to 10,000 MeV, for mesons (π) it is 15 to 15,000 MeV, and for mesons (K) is approximately 50 to 50,000 MeV. (J.F.P.)

51883 (UCRL–19220) THE ZERO-MASS-LIMIT APPROACH TO KINEMATICS AND VENEZIANO PARAMETERIZATIONS FOR PHOTON AMPLITUDES. Brower, Richard C. (California Univ., Berkeley. Lawrence Radiation Lab.). July 30, 1969. Contract W-7405-eng-48. 53p. Dep. CFSTI.

The covariant photon amplitude is proved to be the smooth limit of the helicity amplitude for a massive vector boson. The kinematical consequences of this zero-mass limit and crossing are shown to include conservation of charge (or the equivalence principle in the case of the graviton), and the low energy theorems for photoproduction and Compton scattering. Consequently, the zero-mass limit is a practical alternative to the use of on-mass-shell gauge invariance. Moreover, the zero-mass limit provides a technique for the construction of Regge expansions and Veneziano parameterizations for photon amplitudes from the corresponding amplitudes for a massive vector boson. A model for the Pomeranchon which contributes to forward elastic Compton scattering and does not fall off at large q^2 is proposed. Also a Veneziano parameterization of the amplitude for Compton scattering of off-mass-shell charged currents off pions is presented which satisfies the current algebra sum rule of Fubini, Dashen, and Gell-Mann. (auth)

51884 PROTON–DEUTERON BREMSSTRAHLUNG. Khalil, Ahmad B. (Cairo Univ.). Z. Phys., 227: 320-5(1969).

The p-d Bremsstrahlung cross section is estimated at the laboratory energy of 156 MeV for the proton and energies between 25 and 70 MeV for the γ-rays. It is found that, within the approximations used, the theory is in fair agreement with experiment; and that the cross section depends weakly on the internal motion of the deuteron. (auth)

51885 ON THE INTENSITY-DEPENDENT FREQUENCY SHIFT IN COMPTON SCATTERING. Ehlotzky, F. (Univ. of Alberta, Edmonton). Phys. Lett., 29A: 668-9(Aug. 25, 1969).

The discrepancies in the calculations of high intensity Compton scattering are shown to arise from different formulations of the asymptotic conditions. (auth)

51886 INFLUENCE OF THE EXTERNAL MAGNETIC FIELD UPON SOME QUANTUM PROCESSES. Leventuev, V. P.; Pavlova, O. S.; Khalilov, V. R. Vestn. Mosk. Univ., Ser. III. Fiz. Astron., No. 4, 89-93(July-Aug. 1969). (In Russian).

The influence of external magnetic field on the pair production of scalar particles by two photons and on the process of photon scattering on bosons was studied. It was found that magnetic fields reduced the total cross section of pair photoproduction of scalar particles. (tr-auth)

51887 DETERMINATION OF THE IONIZATION AND ABSORBED ENERGY IN THE REGIONS OF ELECTRONIC NON-EQUILIBRIUM IN AN ENVIRONMENT SUBJECTED TO γ RAYS FROM ^{60}Co. Bernard, Michel; Martin, Christian; Martin, Paule-Noelle (Faculte des Sciences, Limoges, France. Center de Cobaltherapie Chenieux, Limoges, France). Compt. Rend., Ser. A, B, 267: 1297-1300(Dec. 4, 1968). (In French).

A relation established from magnitudes already known in the regions of electronic equilibrium of the environments permits one to anticipate the ionization in the vicinity of interfaces where the values depend on the photon propagation direction. (tr-auth)

51888 MUON PAIR PRODUCTION BY A HIGH ENERGY ELECTRON. Yamamoto, Takao (Hirosaki Univ., Japan). Sci. Rep. Hirosaki Univ., 15: No. 12, 1-5(Dec. 1968).

Muon pair production by an electron in the energy range of 1 to 5 GeV was discussed. Using Feynman diagrams, a general formula for the cross section was derived. The cross section consists of two parts, d σ_1 for the process involving a time-like virtual photon, and d σ_2 for the process involving a space-like virtual photon. In the special case in which the emitted muons lie on the same plane with the incident electron, have same energy $E^+ = E^-$ and make an equal angle $\theta^+ = \theta^-$ on both sides of the incident electron, a formula was obtained by integrating with respect to final direction of the electron. In this case, the cross section d σ_2 vanishes when the emitted angle $\theta^\pm$ tends to zero, so that for forward emission of muons, the main contribution to the cross section comes from the process involving only a time-like virtual photon. The energy spectra of muons were numerically calculated and illustrated for the incident energy $E_0 = 1$ to 5 GeV. It was concluded that the most suitable energy of the incident electron is about 2 GeV. (NSA of Japan)

51889 MUONIC CHARGE AND MUONIC PHOTONS. Okun, L. B. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz., 10: 358-62(Aug. 1969). (In Russian).

Possible physical phenomena are discussed due to the existence of hypothetical leptonic and muonic "photons" whose sources are the conserved leptonic and muonic charges, respectively. It is shown that in framework of the discussed scheme the electric charge of the muonic neutrino may be nonzero, and the electric charges of the muon and electron are not equal, $e_\mu - e_e = e_{\nu_\mu}$. Analyzing the experimental and astrophysical data, upper bounds are given for the electron leptonic charge l_e, muonic charges of the muon f_μ, and the muonic neutrino f_{ν_μ}, as well as for the electric charge of the muonic neutrino e_{ν_μ} and for the difference $e_\mu - e_e$. If the ν_μ mass is more than 1 keV then based on the cosmological arguments it is possible to put also a lower bound for f_{ν_μ}. (auth)

51890 PRODUCTION OF W BOSONS BY SUPERHIGH-ENERGY γ QUANTA. Ioffe, B. L.; Shabalin, E. P. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz., 10: 363-6 (Aug. 1969). (In Russian).

The total cross section of the reaction $\gamma + p \rightarrow W^+ +$ (hadrons) is calculated by means of current algebra methods for superhigh-energy γ quanta. The cross section is estimated to be $\sigma \sim 10^{-33}$ cm^2 at E_γ about 10^{13} eV. (auth)

51891 PHOTOPRODUCTION OF π^0 MESONS OF NUCLEI AT HIGH ENERGIES. Tsarev, V. A. (Lebedev Inst. of Physics, Moscow). Yadern. Fix., 10: 367-72(Aug. 1969). (In Russian).

It is shown that by measuring the cross section of the π^0 meson photoproduction on nuclei one can investigate the Regge trajectory of the ω meson, determine the sign of the $\pi^0 \rightarrow 2\gamma$ decay amplitude and test the predictions of the vector-dominance model. (auth)

51892 THE PROCESS $\gamma\pi \rightarrow \pi\pi$ IN THE VENEZIANO MODEL AND THE POSSIBILITY OF ITS STUDY IN THE REACTIONS $\pi \rightarrow 2\pi$ IN THE COULOMB FIELD OF NUCLEI. Iroshnikov, G. S.; Nikitin, Yu. P.; Chernov, A. S. (Moscow Engineering and Technical Inst.). JETP Lett. (USSR) (Engl. Transl.), 10: 95-8(Aug. 5, 1969).

Translated from Zh. Eksp. Teor. Fiz. Pis'ma Redaktsiyu, 10: 150-3(Aug. 5, 1969).

The amplitude of the interaction $\gamma + \pi \rightarrow \pi + \pi$ is determined in the Veneziano and vector-dominance models. It is found that the use of the Veneziano model in lieu of the vector-dominance model gives reasonable quantitative results giving the kinetic region where the Coulomb mechanism of the meson (π) reactions with a nucleus producing two mesons (π) predominates as well as information on the cross section of the interaction $\gamma + \pi \rightarrow \pi + \pi$. The total cross section for the interaction $\gamma + \pi \rightarrow \pi + \pi$ is found to be 260 μb. (J.F.P.)

51893 LONGITUDINAL DISTANCES IN GAMMA QUANTUM SCATTERING AND ASYMPTOTIC ELECTROPRODUCTION CROSS SECTIONS. Ioffe, B. L. JETP Lett. (USSR) (Engl. Transl.), 10: 90-3(Aug. 5, 1969).

Translated from Zh. Eksp. Teor. Fiz. Pis'ma Redaktsiyu, 10: 143-6(Aug. 5, 1969).

It was shown previously that the question of the longitudinal distances that play a role in the scattering of virtual gamma quanta by nucleons at high energies can be clarified by analyzing the dependence of the imaginary part of the amplitude for the forward scattering of a virtual gamma quantum with mass q^2 by a nucleon, $\mathrm{Im}M_{\mu\nu}(\nu,q^2)$ on q^2 ($\nu = pq$, p and q are the momenta of the nucleon and of the gamma quantum). Various relations of the longitudinal distances for photon scattering and asymptotic electroproduction cross sections are reviewed and discussed. The asymptotic behavior of $\mathrm{Im}M_{\mu\nu}(\nu,q^2)$ (when $\nu \rightarrow \infty$, $|q^2| \rightarrow \infty$, and $\omega = |q^2|/\nu$ = constant) is considered. (J.F.P.)

51894 NEUTRAL PARTICLES OF SPIN I. Casanova, M. Gaston. Compt. Rend., Ser. A, 268: 673-6(Mar. 24, 1969). (In French).

The Dirac–Hestenes wave equation for particles of $\frac{1}{2}$ m and $\frac{1}{2}$ e is solved for neutral particles of spin-1 and in particular for photons of zero and non-zero self-mass. (C.E.S.)

51895 MASS DEFECT AND GAUGE INVARIANCE IN THE INTERACTION THEORY OF WHEELER AND FEYNMAN. Costa de Beauregard, Olivier (Institut Henri Poincare, Paris). Compt. Rend., Ser. A, 268: 574-6(Mar. 10, 1969). (In French).

It is shown that the Wheeler–Feynman interaction momentum–energy expression can be reduced to an expression representing precisely, without an additive constant, the interaction momentum–energy of a system of two repulsive charges in interaction. This can be extended to the general case of n interacting charges. Gauge transformations harmonizing with the general formalism of the Wheeler–Feynman gauge. (C.E.S.)

51896 CUT DOMINANCE, FUBINI SUM RULE, AND THE RELATION BETWEEN HIGH ENERGY SCATTERING AND ELECTROMAGNETIC FORM FACTORS. Arnold, Richard C. (Argonne National Lab., Ill.). pp 136-43 of Proceedings of the 1969 Regge Cut Conference, Madison, Wisconsin, April 23–25, 1969. Part II. Fishbane, Paul M.; Simmons, L. M. Jr. (eds.). Madison, Wis., University of Wisconsin, 1969.

See CONF-690430–(Pt.2).

A derivation of the proportionality relation $d\sigma/dt \rightarrow G_{Ep}(t)^4$ const. is outlined. This derivation is not based on explicit quark or droplet assumptions but instead on various other assumptions concerning the composite structure of particles and the interaction of electromagnetic fields with hadrons. The approach used suggests ultimately other relations possibly as good as the relation studied, and provides more detailed structure concerning the hadronic parts of electromagnetic and weak current matrix elements at high energies. A connection between scattering and form factors is made considering the Fubini sum rule for the charge-antisymmetric Compton scattering of isovector photons from a spinless target. A configuration is selected which allows ideas related with multiple-scattering Regge cuts to dominate. The charge-exchange scattering of a vector meson on the target with helicity nonflip amplitude is also considered. (J.F.P.)

51897 CONSPIRACY IN THE PHOTOPRODUCTION OF CHARGED PIONS IN THE VENEZIANO MODEL. Bender, I.; Rothe, H. J. (Univ., Heidelberg). Nuovo Cim., Lett., 2: 477-81(Oct. 1, 1969).

An application of Veneziano model is made to the photoproduction of charged pions on nucleons. The general features predicted by the model are studied. In particular, it is determined whether the special problems associated with the existence of a forward peak (such as conspiracy and evasion) and the requirement of gauge invariance can be incorporated into a Veneziano-type model. It is found that this is possible and some consequences are discussed with the requirement that all particles lie on Regge trajectories. (J.F.P.)

51898 INCOHERENT PRODUCTION OF ρ^0 MESONS FROM NUCLEI AND VECTOR DOMINANCE. von Bochmann, G.; Margolis, B. (Deutsches Elektronen-Synchrotron, Hamburg. McGill Univ., Montreal). Phys. Rev. Lett., 23: 939-41(Oct. 20, 1969).

Incoherent photoproduction of ρ^0 mesons on the nucleus is calculated assuming vector dominance. The results are sensitive to the ρ-nucleon total cross section which is found to decrease with energy. One finds a relatively weak dependence on energy of the incoherent effective nucleon number. (auth)

51899 VECTOR-DOMINANCE MODEL PREDICTIONS FOR $\Delta(1240)$ PHOTOPRODUCTION. Gotsman, E. (Univ. of California, San Diego, La Jolla). Nuovo Cim., Lett., 2: 563-6 (Oct. 11, 1969).

The photoproduction of $\Delta(1236)$ in the interactions $\gamma + p \rightarrow \pi^- + \Delta^{++}$ and $\gamma + n \rightarrow \pi^+ + \Delta^-$ is discussed. The t-channel contribution to the u-channel process when u is positive and large and t is finite is found. From this it is found that there is a detectable interference effect between the ρ and ω amplitudes when they are of comparable magnitude. The cross sections and spin-density matrix elements are calculated for the $\gamma + p \rightarrow \pi^- + \Delta^{++}$ interaction. Vector dominance model predictions can also be obtained for the $\gamma + n \rightarrow \pi^+ + \Delta^-$ interaction using the same parameters but reversing the sign on all amplitudes contributing to ρ production. (J.F.P.)

51900 POLARIZATION EFFECTS IN COMPTON SCATTERING BY RELATIVISTIC ELECTRONS. Gol'dman, I. I.; Khoze, V. A. (Inst. of Physics, Erevan). Zh. Eksp. Teor. Fiz., 57: 918-21(July 1969). (In Russian).

Polarization properties of γ-quanta produced during compton scattering of laser photons by relativistic electrons are considered. Expressions are also obtained for the polarization parameters of photons emitted during scattering of an intense wave by electrons. (auth)

51901 INTENSITY AND POLARIZATION OF RADIATION MULTIPLY SCATTERED BY FREELY ORIENTED PARTICLES OR MEDIUM FLUCTUATIONS. Gnedin, Yu. N.; Dolginov, A. Z.; Silant'ev, N. A. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksp. Teor. Fiz., 57: 988-1001(July 1969). (In Russian).

Multiple scattering of light by freely oriented particles (electrons, atoms, molecules, macroscopic particles) and medium fluctuations is considered. The intensity and polarization of radiation from a point isotropic or anisotropic source in an infinite medium and the polarization of radiation scattered by a layer of large optical thickness are calculated. (auth)

51902 VAVILOV–CHERENKOV RADIATION IN A MEDIUM WITH INVERSE LEVEL POPULATION. Krasovitskii, V. B.; Kurilko, V. I. (Kharkov State Univ.). Zh. Eksp. Teor. Fiz., 57: 864-9(July 1969). (In Russian).

A nonlinear theory of Cherenkov excitation of longitudinal oscillations and transverse waves in a transparent inverted dielectric by a given modulated current is considered. The maximum amplitudes and characteristic times of the radiation induced in the medium by a current are calculated. The physical mechanism of stabilization of growth of the field amplitude is discussed. (auth)

51903 NONLINEAR THEORY OF CHERENKOV EXCITATION OF REGULAR OSCILLATIONS BY A MODULATED BEAM OF CHARGED PARTICLES. Kurilko, V. I. (Physical-Technical Inst. of Low Temperatures, Kharkov). Zh. Eksp. Teor. Fiz., 57: 885-93(July 1969). (In Russian).

The nonlinear nonstationary problem of excitation of quasi-monochromatic cavity oscillations by a density-modulated charged particle beam is considered. Equations are derived which define the dependence of the field amplitude and phase on time in the case when the flight time is small compared to the characteristic time of growth of the field. Maximal values of the amplitude are calculated in the cases of strong and weak beam modulation. (auth)

51904 STIMULATED EMISSION OF RADIATION BY ELECTRONS MOVING IN THE FIELD OF A PLANE ELECTROMAGNETIC WAVE. Bagrov, V. G.; Klimenko, Yu. I.; Khalilov, V. R. (Moscow State Univ.). Zh. Eksp. Teor. Fiz., 57: 922-6(July 1969). (In Russian).

The dependence of stimulated emission of radiation by electrons moving in the field of a plane electromagnetic wave on the polarization, frequency and spectral width of the second wave perturbing the system is investigated. With an accuracy to terms linear in the Planck constant h the intensity of radiation from a spinor particle (electron) and a nonspinor particle (boson) is found to be the same. (auth)

Weak

Refer also to abstract 51980.

51905 (JINR-P1-4557) WEAK-ELECTROMAGNETIC K-MESON DECAYS. Maltsev, E. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1969. 16p. (In Russian). Dep. CFSTI (U. S. Sales Only).

The properties of weak-electromagnetic K-meson decays are analyzed in detail. The results of the first stage experiments of such transitions are discussed. (auth)

51906 (NYO-1932(2)-156) EQUIVALENCE OF SUM RULES FOR $K_L - K_S$ DECAY. Wick, G. C. (European Organization for Nuclear Research, Geneva (Switzerland)). Aug. 12, 1969. 7p. Dep. CFSTI.

It is shown that the standard Lee-Oehme-Yang treatment and the S-matrix approach for sum rules for $K_2 - K_1$ decay are entirely equivalent. Specifically it is shown that the sum rules agree completely, the standard method when applied to the S matrix problem yields all the results of the pure S matrix approach, and one can proceed conversely from the pure S-matrix formulas back to all the results of the usual treatment. (J.F.P.)

51907 (UCRL-19300) CHARGED PION LIFETIME MEASURED IN FLIGHT. Greenberg, Arthur J. (California Univ., Berkeley. Lawrence Radiation Lab.). Aug. 1, 1969. Contract W-7405-eng-48. 157p. Dep. CFSTI.

The lifetime of the charged pi meson was found by determining as a function of distance the number of surviving pions in a narrow beam. Measurements for both π^+ and π^- were made along a 36-ft decay path, equivalent to 0.6 lifetime, using a movable pion detector. The monitor counters defining the beam were designed so that the measured attenuation with distance was due solely to pion decay and not to loss of scattered particles. The attenuation together with the pion velocity, derived from a precise time-of-flight measurement, determined the lifetime. The movable counter and the pion detector in the monitor system were differential Čerenkov counters with a liquid hydrogen radiator. The lifetime measured in this experiment with pions in flight, 26.02 ± 0.04 nsec, is in agreement with other equally precise experiments with positive pions at rest. Comparison of the lifetimes measured with pions in these two states of motion is relevant to the question of microcausality in field theory. (auth)

51908 THEORY OF WEAK INTERACTIONS IN PARTICLE PHYSICS. Marshak, Robert E.; Riazuddin; Ryan, Ciaran P. Interscience Monographs and Texts in Physics and Astronomy. Volume XXIV. New York, John Wiley and Sons, Inc., 1969. 774p. $29.95.

Weak interaction theory is placed in the framework of particle physics, and mathematical techniques are summarized. Leptonic weak process, hypercharge-conserving and hypercharge-changing semileptonic processes, and hadronic weak processes are discussed. The intermediate boson hypothesis is also discussed, and experiments are suggested for testing some theoretical ideas. Sufficiently detailed proofs of major results of the theory are given, and the nature of the approximations and possibility of improved calculations are pointed out. (J.F.P.)

51909 ON THE DECAY $K_1^0 \rightarrow 1^+1^-$. Rupertsberger, H. W. (Univ., Vienna). Z. Phys., 228: 332-6(1969).

Using one of the models of Gell-Mann et al. the intermediate vector meson mass is estimated by using the upper limit for the decay of the K_1^0 meson into a lepton pair. This mass turns out to be very large. Therefore only the leading terms are taken into account. (auth)

51910 VERIFICATION OF THE CONSEQUENCES OF THE $\Delta T = \frac{1}{2}$ RULE IN THE $K \rightarrow 3\pi$ DECAY. Belavin, A. A. JETP Lett. (USSR) (Engl. Transl.), 9: 45-6(Jan. 5, 1969).

Translated from Zh. Eksp. Teor. Fiz. Pis'ma Redaktsiyu, 9: 76-8(Jan. 5, 1969).

A previous relation for the total probabilities of the τ decay from the $\Delta T = \frac{1}{2}$ rule is studied. Since this relation contains meson (π) scattering lengths, which are not well known, it was also noted that the effect of scattering can be decreased by

comparing the total probabilities near the center of the Dalitz plot. A relation for the total probabilities in a circle of radius R with center at the center of the Dalitz plot divided by the area of the circle is presented. (J.F.P.)

51911 CAN ELECTROMAGNETIC INTERACTIONS OF W BOSONS CUT OFF WEAK INTERACTIONS? Ioffe, B. L. JETP Lett. (USSR) (Engl. Transl.), 10: 36-7(July 5, 1969).

Translated from Zh. Eksp. Teor. Fiz. Pis'ma Redaktsiyu, 10: 53-5(July 5, 1969).

An attempt is made to determine on the basis of an analysis of the perturbation theory diagrams whether allowance for the electromagnetic interactions of the W bosons can lead to a cutoff of the divergences in the amplitudes of hadron-lepton weak interactions. It is concluded that it is unlikely that W boson electromagnetic interactions can cut off the growth of weak interactions. (J.F.P.)

Strong (General)

Refer also to abstracts 51938, 51978, and 51983.

51912 (COO-264-520) QUARK MODEL. Freund, Peter G. O. (Chicago Univ., Ill.). Sept. 1969. Contract AT(11-1)-264. 28p. (CONF-690813-5; EFI-69-84). Dep. CFSTI.

From High Energy Physics Conference, Boulder, Colo.

Aspects of the quark model are treated which explain properties of normal hadrons. Quark model theory relations with standard methods of relativistic quantum theory is emphasized. The U(6) × U(6) × O(3) rest symmetry and the corresponding collinear $U(6)_W \times O(2)_{L_z}$ symmetry, universal meson couplings and exchange degeneracy, a relation among total cross sections, and universality properties of higher-spin meson couplings are covered. Also discussed are exchange degeneracy for baryons, the relevance of quark model diagrams for understanding duality, and an outline of open problems for the quark model. (J.F.P.)

51913 OVERLAPPING RESONANCES AND S-MATRIX UNITARITY. McVoy, K. W. (Los Alamos Scientific Lab., N. Mex.). Ann. Phys. (N. Y.), 54: 552-65(Oct. 1, 1969).

If two overlapping resonances of the same spin and parity, both coupled to C open channels, are superimposed on an energy-independent background, unitarity imposes 2(C + 1) constraints on their S-matrix residues (i.e., partial widths and phases). These constraints are worked out explicitly for the general case of a nondiagonal background matrix (direct reactions present), and compared with the simpler Breit-Wigner constraints which obtain when the resonances are nonoverlapping and the background is elastic. The phase angles of the two resonances are found to be related in an especially simple manner when the background is elastic. The case of T-violating interactions is considered briefly. (auth)

51914 TWO-REGGEON/PARTICLE VERTEX. Drummond, I. T. (Cambridge Univ., Eng.). pp 51-60 of Proceedings of the 1969 Regge Cut Conference, Madison, Wisconsin, April 23-25, 1969. Part I. Fishbane, Paul M.; Simmons, L. M. Jr. (eds.). Madison, Wis., University of Wisconsin, 1969.

See CONF-690430-(Pt.1).

The coupling together of two Reggeons and a spinless particle is considered. The treatment may be regarded as a preparation for the discussion of the three-Reggeon vertex which it is supposed will be relevant to understanding the Reggeon-cut interaction. There are also implications for the nature of wrong signature dips in differential production cross sections. (J.F.P.)

51915 SELF CONSISTENT ASYMPTOTIC BEHAVIOR. Hwa, Rudolph C. (State Univ. of New York, Stony Brook). pp 152-63 of Proceedings of the 1969 Regge Cut Conference, Madison, Wisconsin, April 23-25, 1969. Part II. Fishbane, Paul M.; Simmons, L. M. Jr. (eds.). Madison, Wis., University of Wisconsin, 1969.

See CONF-690430-(Pt.2).

A bootstrap calculation of the asymptotic behavior of scattering amplitudes is discussed. The bootstrap condition used is very weak but it possesses nontrivial dynamical significance. Unitarity and analytic interpolation are used. The unitarity equation involves two Reggeons in the intermediate state from elastic threshold to infinity; and the analytic interpolation implies the meaningfulness of the definition of an amplitude for the scattering of two stable particles into two Reggeons. The scattering of two spinless particles of unit mass into two Reggeons is considered. It is assumed that the high-energy-produced particles form two clusters. It is concluded that the Pomeranchuk singularity can bootstrap itself and that it is a branch point rather than a pole. (J.F.P.)

51916 REGGE CUTS IN ELASTIC SCATTERING. Arnold, Richard C. (Argonne National Lab., Ill.). pp 164-74 of Proceedings of the 1969 Regge Cut Conference, Madison, Wisconsin, April 23-25, 1969. Part II. Fishbane, Paul M.; Simmons, L. M. Jr. (eds.). Madison, Wis., University of Wisconsin, 1969.

See CONF-690430-(Pt.2).

The development of Regge cut phenomenology for hadron interactions with hadrons is surveyed. Emphasis is placed on elastic scattering; but charge-exchange scattering, which can be considered as a difference between isospin eigenamplitudes for elastic scattering is also discussed. The l-plane oriented schemes for truly asymptotic elastic scattering amplitudes, i.e., Pomeranchuk singularities, and secondary effects including lower lying singularities and secondary poles are considered. (J.F.P.)

51917 ON THE UNITARIZATION OF THE VENEZIANO MODEL. Humble, S. (Univ. of Colorado, Boulder). Nuovo Cim., Lett., 2: 541-7(Oct. 11, 1969).

A series expansion in terms of the Veneziano representation in which corrections to a first-order result can be found is suggested. This expansion is crossing symmetric to every order. It produces finite resonance widths and satisfies low-energy unitarity conditions in all three channels. (J.F.P.)

Strong (Baryon No. = 0)

Refer also to abstract 52014.

51918 (ITF-69-40) UPPER BOUND FOR THE PARTIAL-WAVE SCATTERING AMPLITUDE. Kontrosh, J. E.; Lomsadze, Yu. M. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1969. 12p. (CONF-690417-16). Dep. CFSTI (U. S. Sales Only).

From 3rd Conference on Axiomatical Field Theory and Theory of Elementary Particles, Kiev, USSR.

Four Phragmen-Lindelöf theorems and the lemma on Herglotz functions are modified. With their help the boundedness of the partial-wave amplitude Fe(s) in the complex upper s halfplane is proved from the analyticity thereof in this halfplane only. In all the proofs one takes into account that the partial-wave amplitude Fe(s) for real s is a distribution rather than a usual function. (auth)

51919 (NAL-29) STUDY OF THE $\pi\pi$ SYSTEM FROM THRESHOLD TO 1 GeV. Malamud, Ernest; Schlein, Peter (National Accelerator Lab., [Batavia, Ill.]). May 1969. 42p. (CONF-690521-8). Dep. CFSTI.

From Conference on the $\pi\pi$ and K-π Interactions, Argonne, Ill.

A detailed angular correlation analysis was performed on a high statistics compilation of the reaction $\pi^-p \to \pi^-\pi^+n$. This analysis, using the peripheral one-pion exchange dominated events, provided measurements of the following: s-wave $\pi\pi$ phase shifts from the K-mass to 1 GeV, ρ^0 parameters, and certain combinations of the helicity amplitudes. The problem of using $\pi^-p \to \pi^-\pi^0p$ to measure δ_0^2 is discussed. The phase shifts are compared with results from pole extrapolation and it is shown how the helicity amplitudes obtained can be used to make predictions for other reactions. (auth)

51920 (NYO-1932(2)-149 S-MATRIX PHENOMENOLOGY OF $\pi\pi$ SCATTERING. Tryon, E. P. (Columbia Univ., New York). May 1969. Contract AT(30-1)-1932. 23p. (CONF-690521-7). Dep. CFSTI.

From Conference on the $\pi\pi$ and k-π Interactions, Argonne, Ill.

The phenomenological approach to analyticity, unitarity, and crossing symmetry of the S-matrix is described. It is shown how these properties of the S-matrix can be used to determine the $\pi\pi$ phase shifts up to energies approaching 1 GeV in terms of resonance masses and widths and the S-wave scattering lengths a_I and I = 0, 2. The relevant equations are set up, and the method for solving them is outlined. Also the numerical values of a_I and the phase shifts implied by them are discussed. (J.F.P.)

51921 (NYO-1932(2)-150) LOW-ENERGY PION-PION PARAMETERS FROM FORWARD DISPERSION RELATIONS. Morgan, D. (Rutherford High Energy Lab., Chilton (England)); Shaw, G. (Columbia Univ., New York). May 1969. Contract AT(30-1)-1932. 17p. (CONF-690521-6). Dep. CFSTI.

From Conference on the pi-pi and K-pi Interactions, Argonne, Ill.

Model-independent low-energy parameters for $\pi\pi$ scattering are predicted from knowledge of the amplitude in the meson (ρ) region. The main results are an essentially unique prediction of the p- and d-wave phase shifts, values of the s-wave scattering length corresponding to various assumptions on the sigma resonance. Also a consistency argument is given in favor of super-broad sigmas. (J.F.P.)

51922 (NYO-1932(2)-153) VENEZIANO VERSUS PARTIAL-WAVE DISPERSION RELATIONS: A UNITARY, CROSSING-

SYMMETRIC SYNTHESIS AND THE $\pi\pi$ PHASE SHIFTS. Tryon, E. P. (Columbia Univ., New York). [1969]. 13p. Dep. CFSTI.

A method is proposed for unitarizing Veneziano partial waves in a crossing-symmetric fashion. The method is used to compute $\pi\pi$ S, P, and D-waves. In an approximation valid below 1 GeV, the equations reduce to partial-wave dispersion relations; thus the latter retain some validity despite the essential singularities in Veneziano partial waves. (auth)

51923 (NYO-2262-TA-210) BROKEN CHIRAL SYMMETRY AND THE VENEZIANO MODEL. Cronin, Jeremiah A.; Kang, Kyungsik (Brown Univ., Providence, R. I. Dept. of Physics). [1969]. 10p. Dep. CFSTI.

Chiral symmetry breaking within the $K\pi$ system is investigated when a Veneziano model is assumed for various off mass shell extrapolations. Expressions for the matrix elements of σ terms and the divergence of the strangeness changing current are derived and the implications to chiral symmetry breaking interactions is discussed. Application of the results to the K_{l3} form factors gives $f_k/f_\pi f_+(0) = 1.35$ and the relation $(f_k/f_\pi)^2 = \cos[\alpha'_{k*}(0)(\mu_k^2 - \mu_\pi^2)]$ is obtained. (auth)

51924 PION FORM FACTORS AND PHASE SHIFTS. Shymko, R. M. (Univ. of Rochester, N. Y.); Kamal, A. N. Z. Phys., 228: 120-8(1969).

The problem of determining the P-wave π-π phase-shifts given the modulus of the electromagnetic form factor in the time-like momentum transfer region is discussed. The problem of $K_1^0 - K_2^0$ mass difference is discussed with emphasis on the scalar form-factor rather than models of π-π scattering. (auth)

51925 SECONDARY VENEZIANO TERMS IN $\pi\pi$ AND πK SCATTERING. Antoniou, N. G.; Bartl, A.; Widder, F. (Univ., Tuebingen, Ger.). Z. Phys., 228: 143-50(1969).

The effect of secondary Veneziano terms in $\pi\pi$ and πK scattering is studied. It is found that the scattering lengths change only by 30%. On the contrary the widths of the resonances may be drastically changed and become consistent with unitarity. (auth)

51926 UNITARIZATION OF THE VENEZIANO MODEL, POMERANCHUK SINGULARITY, AND THE PION MASS. Huang, Kerson (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. Lett., 23: 903-6(Oct. 13, 1969).

A general framework is suggested for unitarizing the Veneziano model for $\pi\pi$ scattering, and deduce some immediate consequences. By duality the unitarity s cut generates a moving Regge cut with branch-point trajectory $1 + \alpha' t$ in the approximation $m_\pi = 0$, with α' the slope of the ρ-f^0 trajectory. In principle m_π may be calculated from the shift of the Adler zero. A crude estimate yields $m_\pi \approx (\alpha')^{\frac{1}{2}} m_\rho \Gamma_\rho = 95$ MeV. (auth)

51927 CONNECTION BETWEEN $F_\pi(t)$ AND THE AMPLITUDES FOR $\pi\pi \to \pi\pi$ AND $\pi\pi \to \pi A_1$. Geffen, D. A. (Univ. of Minnesota, Minneapolis). Contract AT(1-11)-1764. Phys. Rev. Lett., 23: 897-900(Oct. 13, 1969).

The current-algebra connection between the pion electromagnetic form factor $F_\pi(t)$ and the amplitudes for $\pi\pi \to \pi\pi$ and $\pi\pi \to \pi A_1$ is examined by explicitly extrapolating off the pion mass shell the matrix element $\langle\pi|A_\mu|\pi\pi\rangle$ which is taken to be dominated by π and A_1 poles and possible subtractions. It is found that the connection is broken by the presence of an almost arbitrary subtraction function. In particular the $A\rho\pi$ interaction remains arbitrary as well as the form for $F_\pi(t)$. The results are applied briefly to the Veneziano model. (auth)

51928 SUM RULES FOR PROCESSES OF MULTIPLE PRODUCTION OF PIONS IN HADRON COLLISIONS. Mal'tsev, V. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 10: 373-7(Aug. 1969). (In Russian).

Sum rules for processes of multiple production of pions in hadron collisions that follow from the quark additive model, are given. The experimental cross sections for the $\bar{p}p$, pp, and $\pi^\mp$ p collisions satisfy the obtained relations. (auth)

51929 SOME CONSEQUENCES OF CHIRAL U(3) x U(3) DYNAMICS FOR VECTOR AND AXIAL VECTOR RESONANCES. Sabo, V. I.; Torich, Z. Z. (Uzhgorod State Univ., USSR). Yadern. Fiz., 10: 378-80(Aug. 1969). (In Russian).

Widths of the resonance decays $1^- \to 0^- + 0^-$ and $1^+ \to 1^- + 0^-$ are calculated on basis of the gauge chiral U(3) x U(3) dynamics. A generalized Weinberg-type mass relation is obtained in reasonable agreement with experiment. The calculations are carried out with two assumptions: the A_μ nonet is composed of D(1286), E(1420), K_A(1230), and A_1(1070), or of D(1286), E(1420), K_A(1320), and A_1(1070). The decay widths are shown to be in reasonable agreement with experiment. (auth)

51930 REGGE POLES AND ABSORPTION: πN, KN, AND NN SCATTERING. Drouffe, J. M.; Navelet, H. (CEN, Saclay, France). pp 205-22 of Proceedings of the 1969 Regge Cut Conference, Madison, Wisconsin, April 23-25, 1969. Part II. Fishbane, Paul M.; Simmons, L. M. Jr. (eds.). Madison, Wis., University of Wisconsin, 1969.

See CONF-690430-(Pt.2).

A Regge pole model corrected by absorption is formulated precisely; and fits are obtained for π + p, K + p, and p + N interactions at high energies. Phenomenological fits are also obtained for other interactions with very few parameters. (J.F.P.)

51931 APPLICATION OF THE GENERALIZED VENEZIANO MODEL TO THE REACTION $\bar{p}p \to 4\pi$. Hopkinson, J. F. L.; Roberts, R. G. (CERN, Geneva). Nuovo Cim., Lett., 2: 466-70 (Oct. 1, 1969).

An application of the generalized Veneziano model is made to data for the interaction $\bar{p} + p \to 2\pi^+ + 2\pi^-$ at rest. The basic idea is that since the $\bar{p}p$ system has the quantum numbers of a meson, it is legitimate to use a Veneziano amplitude where each external particle has integer spin. Thus it is a direct test of the amplitude since no assumptions have to be made concerning fermions. It is concluded that the model agrees well with the data when a satellite term (a term in which the leading trajectory has been decoupled) is added to the leading term. (J.F.P.)

Strong (Baryon No. = 1)

51932 (JINR-P1-4657) ANALYSIS OF THE $\pi^+p \to N^* \rho^0$ AND $\pi^+p \to N^* \omega^0$ REACTIONS AT THE π^+-MESON MOMENTUM OF 2.3 GeV/c. Angelov, N.; Gramenitskii, I. M.; Kanazirski, Kh.; (and others) (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1969. 27p. (In Russian). Dep. CFSTI (U. S. Sales Only).

The slope parameters and the behavior of the differential cross section $d\sigma/dt'$ in the $\pi^+p \to N^*\rho^0$ and $\pi^+p \to N^* \omega^0$ reactions are discussed. The angular distributions of π^*, ρ^0 and ω^0 resonance production and decay as well as the angular correlations between the resonances are considered with the help of the common spin density matrix. (auth)

51933 REGGE RESIDUES IN THE VENEZIANO MODEL. Jones, Lorella; Wyld, H. W. Jr. (Univ. of Illinois, Urbana). Phys. Rev. Lett., 23: 814-16(Oct. 6, 1969).

It is shown how the Veneziano five-point function may be used as a model for Regge residues in quasi-two-body processes. An artificial reaction with many of the properties of $\pi N \to \pi\pi N$ is studied in this model; density matrices for spin-1 and spin-2 resonances produced by pion exchange are calculated. The results are encouraging enough to warrant construction of a more detailed model along these lines. (auth)

51934 MAGNETIC MOMENTS OF QUARKS AND THEIR BOND CONSTANTS WITH MESONS ($s = 0^-$) AND ($s = 1^-$). Bas'yuni, A.; Kurdgelaidze, D. Vestn. Mosk. Univ., Ser. III. Fiz. Astron., No. 4, 107-10(July-Aug. 1969). (In Russian).

Expressions were obtained for the strong coupling constants and magnetic moments of baryons and quarks. (R.V.J.)

51935 SUPERCONVERGENT RELATIONS FOR $\pi N^* \to \pi N^*$. Alam, M. Anis (Panjab Univ., Lahore). J. Natur. Sci. Math., 9: No. 1, 1-7(Apr. 1969).

Superconvergence relations for the process $\pi N \to \pi N^*$ are obtained in terms of helicity amplitudes. For saturation of these relations, N,N^* are put in as intermediate states. The resulting sum rules for the process $\pi N^* \to \pi N^*$ give results consistent with group theoretic results. (auth)

51936 HELICITY AMPLITUDES SUPERCONVERGENT RELATIONS FOR $\pi N \to \pi N^*$. Alam, M. Anis (Panjab Univ., Lahore). J. Natur. Sci. Math., 9: No. 1, 9-11(Apr. 1969).

Superconvergence relations for the inelastic scattering process $\pi N \to \pi N^*$ are obtained in terms of kinematic singularity free t-channel helicity amplitudes. These relations on saturation with low lying baryon resonances yields results consistent with group theoretic ones. (auth)

51937 ON THE BEHAVIOR OF THE πN PARTIAL WAVE AMPLITUDES AT s = 0. Jakob, H.-P. (Univ., Karlsruhe, Ger.); Steiner, F. Z. Phys., 228: 353-70(1969).

The behavior of the πN partial wave amplitudes in the limits $s \to +0$ and $s \to -0$ is related to backward scattering in the s- and t-channel, respectively. Assuming Mandelstam analyticity it is proved with the aid of the Pragmèn–Lindelöf theorem that the amplitudes for high energy backward scattering in $\pi N \to \pi N$ and $\pi\pi \to N\bar{N}$ are equal and therefore dominated by the same exchange mechanism, namely Reggeized fermion exchange. The dominating Regge trajectory is the Δ_δ-trajectory, and it is shown that the πN

partial wave amplitudes diverge for $s \to \pm 0$ as $s^{-\alpha\Delta\delta(0)-1/2}$. Reduced amplitudes are defined which are regular at s = 0. Using recent results of πN backward scattering real and imaginary part of the s-wave amplitude $f_{0+}^{(-)}$ are calculated in the interval $0 \leqq s \leqq 7$. (auth)

51938 MASS RELATIONS BETWEEN BARYON WITH $J_P = 1/2^+$ AND $3/2^+$, DERIVED FROM THE BINDING ENERGIES OF THE QUARKS. Koch, Joachim. Z. Phys., 228: 322-8(1969). (In German).

The non-relativistic three quark model of the baryons including mass differences depending on the electromagnetic as well on the hypercharge is studied. Assuming that the binding energies between two quarks in the baryons are the well known linear combinations of the binding energies, different mass formulas between the baryons are verified. Some ones can be verified without additional assumptions, other ones only by supposing relations between the binding energies. (auth)

51939 REGGE POLE MODEL FOR INVARIANT FUNCTIONS. V. πN CHARGE EXCHANGE AND ELASTIC SCATTERING. Kroll, P.; Traenkle, E. (Freie Univ., Berlin). Z. Phys., 228: 295-307 (1969).

The total cross section, the differential cross section and the polarization data of πN charge exchange as well as elastic scattering is described by the four p, p', P, P' Regge type poles in good agreement with experiment. (auth)

51940 RANDOM PHASE APPROXIMATION AND ABSORPTION MODEL. Rivers, R. J. (Univ. of Chicago). pp 144-51 of Proceedings of the 1969 Regge Cut Conference, Madison, Wisconsin, April 23–25, 1969. Part II. Fishbane, Paul M.; Simmons, L. M. Jr. (eds.). Madison, Wis., University of Wisconsin, 1969. See CONF-690430-(Pt.2).

Some comments are made on the inclusion of inelastic intermediate states in initial- and final-state interactions with charge-exchange scattering. The random phase approximation and the absorption model are used. Restriction is made to the case of $\pi^- + p \to \pi^0 + n$ interactions. (J.F.P.)

51941 PHENOMENOLOGY WITH ABSORPTIVE CUT MODELS. Kane, G. L. (Univ. of Michigan, Ann Arbor). pp 175-83 of Proceedings of the 1969 Regge Cut Conference, Madison, Wisconsin, April 23–25, 1969. Part II. Fishbane, Paul M.; Simmons, L. M. Jr. (eds.). Madison, Wis., University of Wisconsin, 1969. See CONF-690430-(Pt.2).

The behavior of scattering amplitudes in absorptive Regge cut models is described, and some hadron backward scattering data are discussed within the framework of the model to show the possibility that this construction of the amplitude is the most appropriate. Brief comments are given on the structure of the model. (J.F.P.)

51942 RESCATTERING AND ABSORPTIVE CORRECTIONS TO THE POMERON. Mickens, R. E. (Massachusetts Inst. of Tech., Cambridge). pp 223-34 of Proceedings of the 1969 Regge Cut Conference, Madison, Wisconsin, April 23–25, 1969. Part II. Fishbane, Paul M.; Simmons, L. M. Jr. (eds.). Madison, Wis., University of Wisconsin, 1969. See CONF-690430-(Pt.2).

It is shown that if the Pomeron is an iterative singularity, then it is not possible at present energies to distinguish between rescattering and absorptive corrections to the Pomeron. The $\pi^+ + p$ and $\pi^- + p$ total cross sections and the phase of the forward scattering amplitude are fitted. (J.F.P.)

51943 NOTE ON PHASE PROBLEM. Henyey, F. (Univ. of Michigan, Ann Arbor). pp 235-9 of Proceedings of the 1969 Regge Cut Conference, Madison, Wisconsin, April 23–25, 1969. Part II. Fishbane, Paul M.; Simmons, L. M. Jr. (eds.). Madison, Wis., University of Wisconsin, 1969. See CONF-690430-(Pt.2).

The phase problem for double rho exchange in $\pi^- + p \to \pi^0 + n$ interactions is studied. The phase problem arises because this interaction has only odd signature whereas double rho exchange has even signature. It thus appears that double rho exchange cannot occur. Yet a Feynman diagram with double elementary rho exchange persists. The solution of this problem depends on the third-double-spectral-function aspect of Regge cuts. The phase problem is studied by comparing two diagrams combining to give odd signature and related by crossing, isospin, etc. It is found that these diagrams are negatives of each other, therefore their sum is zero. The result implies that the two canceling diagrams are both contained in the same model as they are both of the same form. The sum over intermediate states gives a vanishing double rho exchange. (J.F.P.)

51944 AN INDICATION FOR A NONFLAT POMERANCHUK TRAJECTORY FROM THE HARARI–FREUND ANSATZ. Garcia, A. (International Centre for Theoretical Physics, Trieste, Italy); Canal, C. A. Garcia; Odorico, R. Nuovo Cim., Lett., 2: 482-4 (Oct. 1, 1969).

It is pointed out that the Harari–Freund ansatz, when related to finite-energy sum rules for π + N scattering, implies a nonvanishing slope for the Pomeranchuk trajectory. Using the HF ansatz after making the decomposition vacuum exchange = P + P' one can construct P' explicitly with direct-channel resonances through the finite-energy sum rules. This fact can be related to some knowledge of the high-energy real part since the latter is due only to the P' contribution in the limit of an exactly flat Pomeranchuk trajectory. (J.F.P.)

51945 RESCATTERING AND ABSORPTIVE CORRECTIONS TO THE POMERANCHUKON. Mickens, R. E.; Deans, S. R. (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-2098. Nuovo Cim., Lett., 2: 495-500(Oct. 1, 1969).

It is shown that if the Pomeranchukon is an iterative singularity, then it is not possible by using the highest-energy data presently available to distinguish between rescattering and absorptive corrections to the Pomeranchukon. This is done by fitting the $\pi^+(\pi^-)$ + p total cross sections and the phase of the forward scattering amplitude. It is also shown that the sign of the polarization of the final-state proton can be used to distinguish between rescattering and absorptive corrections to the Pomeranchukon for the interaction $\pi^- + p \to A_1^- + p$. (J.F.P.)

51946 HIGH-ENERGY SMALL-ANGLE SCATTERING AND MULTIPLE-SCATTERING CORRECTIONS. Kouris, C. B. (Democritus Nuclear Research Center, Athens). Nuovo Cim., Lett., 2: 531-7(Oct. 11, 1969).

Experimental data for π^- + p elastic scattering at 12 to 18.6 GeV/c and π^+ + p elastic scattering at 12 and 16 GeV/c and small momentum transfers are analyzed in terms of a model which takes into account multiple Pomeranchukon exchange corrections to the scattering amplitude. The contribution of secondary trajectories is also included. Spin effects are neglected as small, and it is assumed that the cut contribution to the scattering amplitude is exclusively due to multiple scattering corresponding to Pomeranchuk exchanges. (J.F.P.)

51947 A RECONSTITUTION OF THE SCATTERING AMPLITUDES SATISFYING THE MOMENT SUM RULES AND ITS APPLICATION TO πA SCATTERING. Kawai, T.; Matsumoto, Y. (Osaka City Univ.). Nuovo Cim., Lett., 2: 511-14(Oct. 11, 1969).

A method for reconstituting the scattering amplitude satisfying the moment sum rules and therefore free from double counting is proposed. Using this method it is possible to evaluate observable quantities numerically. The method is formulated and used to evaluate the total cross sections at intermediate energies for π + N scattering. (J.F.P.)

51948 SPIN AND PARITY ANALYSIS OF THE $\pi\rho$ SYSTEM PRODUCED VIA A DOUBLE-REGGE MECHANISM IN THE REACTION $\pi N \to \rho\pi N$. Froggatt, C. D.; Ranft, G. (University Coll., London). Phys. Rev. Lett., 23: 943-6(Oct. 20, 1969).

A partial-wave analysis is made of the $\pi\rho$ mass enhancement in the A_1 region for the Reggeized Deck amplitude of Berger. It is found that the state is predominantly 1^+ S wave in agreement with the semilocal-duality interpretation of Chew and Pignotti, but the amplitude does not provide a local description of A_1 resonance production. (auth)

51949 ELEMENTARY PARTICLES. Matthews, Paul T. (Imperial Coll. of Science and Tech., London). Proc. Roy. Inst. Gt. Brit., 42: 117-34(1969).

The present situation in nuclear and subnuclear physics is summarized with particular emphasis on recent success. A historical approach is adopted, beginning with the status in 1930. Emphasis is concentrated on the strong interaction. Baryon charge is defined, and hypercharge is introduced. Y-Q plots are drawn for some baryons, and problems of interpretation of the obvious order are explored. Adaptation of the quark theory to fitting particle problems to a newer scheme is illustrated. Predictive powers of theories are related to the discovery of the Ω^- particle. (BBB)

Strong (Baryon No. ≥ 2)

Refer also to abstracts 52028 and 52175.

51950 (DESY–69/28) CONSISTENT APPROACH TO EXCHANGE CURRENTS AND THE NUCLEAR MANY BODY PROBLEM. Stichel, P.; Werner, E. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Aug. 1969. 50p. Dep. CFSTI (U. S. Sales Only).

A consistent treatment of two-particle exchange currents in nuclei in the framework of the one-boson-exchange-model for the nucleon-nucleon interaction is given. Relativistic effects are taken into account up to order $(P/M)^2$. The general formalism for the evaluation of matrix elements of two-body currents in many-nucleon systems is outlined. Possible applications to the two-nucleon system are briefly discussed. (auth)

51951 (JINR-P2-4662) INTERACTION MECHANISM OF HIGH AND SUPERHIGH ENERGY PARTICLES WITH ATOMIC NUCLEI. NEW TYPES OF ELEMENTARY PARTICLE INTERACTIONS. Barashenkov, V. S.; Gudima, K. K.; Eliseev, S. M.; Il'inov, A. S.; Toneev, V. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1969. 17p. (In Russian). (CONF-690814-6). Dep. CFSTI (U. S. Sales Only).

From 11th International Conference on Cosmic Rays, Budapest, Hungary.

The mechanism of intranuclear cascades which is in good agreement with the presently available experimental data on inelastic pion- and nucleon-nucleus interactions in the whole energy range from a few dozens of MeV to a few GeV comes in contradiction with them at higher energies ($T \gtrsim 5$ GeV). To eliminate these disagreements it is necessary to take into account many-particle interactions, production of resonances and changes in the nuclear matter density as the intranuclear cascade develops. The analysis of the experimental data at energies $T \gtrsim 100$ GeV is a unique possibility for investigating a new type of elementary particle interactions when in the initial state three, four or more particles (multiple particle interactions) rather than two, as is usually the case, are involved in the collision. (auth)

51952 REGGE POLE MODEL FOR INVARIANT FUNCTIONS. IV. NN-SCATTERING AND π-PHOTOPRODUCTION WITH POLARIZED TARGETS. Muetter, K.-H. (Freie Univ., Berlin). Z. Phys., 228: 188-92(1969).

The $NN \rightarrow NN$ and $\gamma N \rightarrow \pi N$ differential cross sections for polarized targets are discussed in terms of invariant functions. In former fits of high energy experimental data certain of these invariant functions came out to be small. Based on these fits the $pn \rightarrow np, p\bar{p} \rightarrow n\bar{n}, \gamma p \rightarrow n\pi^+$ and $\gamma n \rightarrow p\pi^-$ differential cross sections are predicted to be independent of the target polarization. (auth)

51953 THREE-NUCLEON MATRIX ELEMENTS IN TRANSLATION-INVARIANT OSCILLATOR STATES. de Llano, Manuel (Univ. Nacional Autonoma de Mexico, Mexico City). Rev. Mex. Fis., 18: 209-31(1969).

A closed formula, suitable for computer programming, is obtained for three-nucleon matrix elements of an arbitrary one-plus-two body hamiltonian operator acting between translation-invariant three-body oscillator states. The formula is a sum of products of: two transformation brackets, two spin-isospin fractional-parentage coefficients, one 12-j symbol and the two-body matrix elements in relative coordinate. It is emphasized that the usefulness of the scheme will depend on the extent to which the two-body matrix elements represent a true effective interaction. (auth)

51954 STUDY OF REACTIONS WITH FORMATION OF TWO RESONANCES IN CASE OF PERIPHERAL pp AND γp INTERACTIONS IN A MODEL WITH A FORM FACTOR. Merenkov, N. P. (Inst. of Physics and Tech., Kharkov). Ukr. Fiz. Zh., 14: 1187-94(July 1969). (In Russian).

Total cross sections of pair formation $\Delta(1238)$-, N(1400)-, and N(1525)-resonances in case of pp-interactions and formation of vector meson (ρ^0, ω) with one of the mentioned baryon resonances in γp-interaction are calculated in a model taking into account the exchange by the π-meson. A necessary decrease of the total cross sections with the increase of the transferred momentum is attained by introduction of the form factor. Comparison of the results obtained with asymptotic limits for the reactions, in which the exchange by the vacuum pole is permitted, showed the total cross sections must have the maximum in the foreasymptotic region of energies characteristic of a one-pion mechanism only for the processes $pp \rightarrow N(1525)\,N(1525)$ and $\gamma p \rightarrow \omega N(1525)$. (auth)

51955 CONSEQUENCES OF THE QUARK MODEL FOR LOW-ENERGY HADRON INTERACTIONS. Rekalo, M. P. (Inst. of Physics and Tech., Kharkov). Ukr. Fiz. Zh., 14: 1181-6(July 1969). (In Russian).

The relation between the cross sections of the processes $\Sigma^- + p \rightarrow \Sigma^0 + n$ and $\Sigma^- + p \rightarrow \Lambda + n$ is found in the quark model. This relation is in good agreement with experimental data for low momenta of Σ^--hyperon. It is shown that the quark mechanism corresponding to the baryon state exchange at low energies makes a contribution comparable with that of the standard quark mechanism corresponding to the meson state exchange. This mechanism is useful for eliminating contradictions of the quark model predictions with experiment. (auth)

51956 INTERACTION OF TWO BODIES WITH AN INFINITE REPULSIVE CORE. Shadchin, S. A. (Inst. of Physics, Kiev). Ukr. Fiz. Zh., 14: 1133-41(July 1969). (In Russian).

A problem for two interacting bodies with an infinite repulsive core is investigated by the method of Brueckner. The expression for the attracting part of the interaction was chosen in the form of the potential with separating variables. In case of s-scattering a dependence of the phase shift on energy is obtained in the explicit form. The wave function of the coupled state of two nucleons is found. Potential parameters are determined by the scattering length and effective radius at low energies and phase shift at high energies. Taking account of the infinite repulsion is shown to result in a considerable increase of the attraction potential depth. The calculated dependence of the phase shift on energy is in satisfactory agreement with the experiment. Correlation energy of two nucleons is calculated. (auth)

51957 PHENOMENOLOGICAL RELATIVISTIC AMPLITUDES FOR REACTIONS $N + N \rightarrow \pi + N + N$. Bogoslovskii, G. Yu.; Rogozhkin, G. A. (Moscow State Univ.). Yadern. Fiz., 10: 381-91(Aug. 1969). (In Russian).

Invariance under the Poincaré transformations for the amplitudes and the consequent form of the amplitudes in an arbitrary reference frame, are considered. The formulas for the observables and the partial expansions necessary for the phase-shift analysis, are presented. (auth)

51958 π MESON SCATTERING ON ^{3}H AND ^{3}He. Gurvitz, S. A. (Moscow Physical-Technical Inst.). Yadern. Fiz., 10: 315-20(Aug. 1969). (In Russian).

Formulas for the π meson scattering amplitudes on ^{3}H and ^{3}He are obtained by means of the Feynman graph technique taking into account the corrections from rescattering. Region for applicability of the results obtained is given. (auth)

51959 MULTIPLE SCATTERING AND REGGE CUTS. Pagnamenta, Antonio (Rutgers-The State Univ., New Brunswick, N. J.). pp 109-27 of Proceedings of the 1969 Regge Cut Conference, Madison, Wisconsin, April 23-25, 1969. Part I. Fishbane, Paul M.; Simmons, L. M. Jr. (eds.). Madison, Wis., University of Wisconsin, 1969.

See CONF-690430-(Pt.1).

The questions of whether the quark model is needed to explain the structure of the differential cross sections for proton-hadron interactions and whether a more accurate calculation would allow one to differentiate between the different models and determine the number of quarks inside a proton are considered. The essential uncertainties are shown for these problems. Also it is shown that these calculations fit well into the framework of Regge theory. Especially the multiple scattering terms provide a simple way of generating Regge cuts with residues corresponding to a selected model. (J.F.P.)

51960 CUT DIAGRAMS IN POTENTIAL THEORY. Harrington, David R. (Rutgers-The State Univ., New Brunswick, N. J.). pp 128-36 of Proceedings of the 1969 Regge Cut Conference, Madison, Wisconsin, April 23-25, 1969. Part II. Fishbane, Paul M.; Simmons, L. M. Jr. (eds.). Madison, Wis., University of Wisconsin, 1969.

See CONF-690430-(Pt.2).

Some features of the Glauber approximation in potential theory are discussed which may help resolve the contradiction that the Glauber approximation for high-energy composite systems predicts Regge cuts in the total scattering amplitude if the two-body amplitudes are dominated by Regge poles but also diagramatic analysis shows that such cuts are not produced by the types of diagrams usually considered as included in the Glauber approximation. Meson (π)-deuteron scattering and a model in which high-energy pion-nucleon scattering is described by energy-dependent optical potentials are considered. (J.F.P.)

51961 CUTS OR SECONDARY TRAJECTORIES? Michael, C. (Univ. of Wisconsin, Madison). pp 184-96 of Proceedings of the 1969 Regge Cut Conference, Madison, Wisconsin, April 23-25, 1969. Part II. Fishbane, Paul M.; Simmons, L. M. Jr. (eds.). Madison, Wis., University of Wisconsin, 1969.

See CONF-690430-(Pt.2).

Empirical evidence for Regge pole and Regge cut behavior of high-energy scattering is discussed. The Glauber-eikonal-absorption prescription for Regge cuts, and evidence of the success of this multiple scattering prescription at high energies from πd scattering are presented. These cut corrections are contrasted with corrections from secondary Regge trajectories in the case of πN charge-exchange scattering. Also exotic quantum number

exchange processes in which the predictions of the multiple (double) scattering model are significantly different from those of possible exotic particle trajectories are considered, and estimations of the double scattering contributions to $K^-p \to pK^-$ and $\pi^-p \to K^+\Sigma^-$ interactions are presented. (J.F.P.)

51962 DIFFRACTIVE PROCESSES AND REGGE CUTS. Margolis, B. (McGill Univ., Montreal). pp 197-204 of Proceedings of the 1969 Regge Cut Conference, Madison, Wisconsin, April 23–25, 1969. Part II. Fishbane, Paul M.; Simmons, L. M. Jr. (eds.). Madison, Wis., University of Wisconsin, 1969. See CONF-690430-(Pt.2).

Preliminary measurements at Serphukov on proton–proton scattering, indicating that p + p shrinkage continues up to 75 GeV laboratory momentum, is taken to imply that this scattering involves the exchange of a Pomeranchuk of finite slope. The nonshrinkage processes therefore would involve a large contribution from lower trajectories. Secondary trajectories are ignored, and amplitudes of $p + p \to p + p$ and $p + p \to N^* + p$ interactions are written. The terms after the first in the obtained series show Regge cut behavior, and this behavior is discussed. (J.F.P.)

51963 ASYMPTOTIC BEHAVIORS OF DIFFRACTION SLOPES OF ELASTIC $\bar{p}p$ AND pp SCATTERING. Masuda, N. (Louisiana State Univ., Baton Rouge); Mikamo, S. Nuovo Cim., Lett., 2: 519-22(Oct. 11, 1969).

The asymptotic behaviors of the diffraction slopes of $\bar{p}p$ and pp scattering are studied including more recent data not previously used and taking account of the property that the slope of the differential cross section becomes less steep as $-t$ increases. First the diffraction slope is determined in the parametrization of differential cross section data at a given incident energy with the method of least chi square fit; then the asymptotic form of the diffraction slopes for $\bar{p}p$ and pp scattering is determined jointly by using the obtained numerical results. (J.F.P.)

51964 PROTON–PROTON ELASTIC LARGE-ANGLE SCATTERING IN THE HIGH-ENERGY LIMIT FROM LINEARIZED UNITARITY RELATION AND WU AND YANG'S CONJECTURE. Masuda, N. (Louisiana State Univ., Baton Rouge); Mikamo, S. Nuovo Cim., Lett., 2: 523-7(Oct. 11, 1969).

The theoretical result of the large-angle proton-proton elastic scattering previously derived from assuming the Regge-pole-like structure in the diffraction region is extrapolated to the high-energy limit and directly compared with the fourth power of the measured magnetic form factor of the proton. The unitarity relation for p + p scattering is used to obtain the expression for the elastic large-angle differential cross sections. This expression is compared in the high-energy limit with the fourth power of the measured proton magnetic form factor. The result seems to support the original Wu and Yang conjecture that the differential cross section of the p + p elastic scattering at high energies is proportional to the fourth power of the proton magnetic form factor. (J.F.P.)

Particle Invariance Principles and Symmetries

General

Refer also to abstracts 51869, 51870, and 52009.

51965 LIE THEORY AND SPECIAL FUNCTIONS. Miller, Willard Jr. Mathematics in Science and Engineering. A Series of Monographs and Textbooks. New York, Academic Press Inc., 1968. 350p. $16.50; 154s.

The relation between Lie groups and special functions of mathematical physics is studied. It is shown that the factorization method is equivalent to representation theory of four local Lie groups. The study of these groups and their Lie algebras leads to a unified treatment of special function theory. Lie algebras having dimensions up to six are studied, and recursion relations and addition theorems are derived. (J.F.P.)

51966 THE SU(8) GROUP AND CLASSIFICATION OF ELEMENTARY PARTICLES. Toth, Lubomir (Purkyne Univ., Czech.). Fyz. Cas., 19: No. 2, 72-84(1969). (In Czech).

A possibility of extending the SU(4) symmetry of elementary particles to the SU(8) symmetry in analogy with the SU(3) → SU(6) symmetries within the framework of the static quark model is presented. Wave functions, mass formulas and magnetic moments are obtained. (JPRS)

51967 DEGENERATE REPRESENTATIONS OF THE SYMPLECTIC GROUPS. II. THE NONCOMPACT GROUP Sp(p,q). Pajas, P. (Nuclear Research Inst., Rez, Czech.). J. Math. Phys. (N. Y.), 10: 1777-88(Sept. 1969).

Using a method based on geometrical properties of homogeneous spaces of rank one homeomorphic to coset spaces of Lie groups, a series of degenerate unitary irreducible representations of the non-compact symplectic group Sp(p,q) is investigated. The representation spaces for a discrete series determined by two integer numbers and a continuous series determined by one real and one integer parameter are given, the corresponding basis functions being formed by the linear combinations of eigenfunctions of the Laplace–Boltrami operator of the considered space. Explicit formulas for the action of generators of Sp(p,q) in these representations are obtained. The results provide a deeper insight into the structure of the two-parameter "not most degenerate" unitary representations. (auth)

51968 ON THE COMBINATORIAL STRUCTURE OF STATE VECTORS IN U(n). II. THE GENERALIZATION OF HYPERGEOMETRIC FUNCTIONS ON U(n) STATES. Ciftan, Mikael (Duke Univ., Durham, N. C.). J. Math. Phys. (N. Y.), 10: 1635-46(Sept. 1969).

The derivation of the explicit algebraic expressions of the SU(n) state vectors in the boson-operator realization is shown to lead to a generalization of hypergeometric functions. The SU(3) state vectors are rederived by the combinatorial method—propounded previously and are shown to be represented by a hypergeometric distribution function and an associated generalization of the Young tableaux calculus. The SU(4) state vectors are also derived to demonstrate the main features of the general U(n) state vectors. The SU(4) state vectors are expressed in terms of the constituents of Radon transforms. (auth)

51969 WIGNER SUPERMULTIPLET SCHEME. Hecht, K. T.; Pang, Sing Chin (Univ. of Michigan, Ann Arbor). J. Math. Phys. (N. Y.), 10: 1571-1616(Sept. 1969).

Calculation of Wigner and Racah coefficients for the group $SU(4) \supset [SU(2) \times SU(2)]$ makes it possible to perform the spin-isospin sums in the cfp (fractional parentage coefficients) expansion of the matrix elements of one- and two-body operators in the Wigner supermultiplet scheme. The SU(4) coefficients needed to evaluate one- and two-particle cfp's, the matrix elements of one-body operators, and the diagonal matrix elements of two-body operators are calculated in general algebraic form for many-particle states characterized by the SU(4) irreducible representations [yy0], [yy − 1 0], [yy1], [y11], [yy − 1 y − 1], [y10], [yyy − 1], [y00], and [yyy], whose states are specified completely by the spin and isospin quantum numbers (y = arbitrary integer). Applications are made to the calculation of the matrix elements of the complete space-scalar part of the Coulomb interaction and the space-scalar part of the particle-hole interaction for nucleons in different major oscillator shells. (auth)

51970 REPRESENTATION THEORY OF SP(4) AND SO(5). Holman III, Wayne J. (Univ. of Miami, Coral Gables, Fla.). J. Math. Phys. (N. Y.), 10: 1710-17(Sept. 1969).

The basis states for all the irreducible unitary representations of Sp(4) are constructed by means of a calculus of boson operators. The Gel'fand states are explicitly expanded in terms of their constituent Weyl patterns. In terms of these states the matrix elements of finite rotations in five dimensions are obtained. (auth)

Applications (Electromagnetic and Weak)

51971 AN EXPERIMENTAL TEST ON PARITY VIOLATION IN NUCLEAR FORCES STUDIED IN $^{113}Cd(n,\gamma)$. Eichler, J.; Heine, P. (Kernforschungszentrum, Karlsruhe, Ger.). Z. Phys., 227: 352-8(1969).

An oriented compound-state in ^{114}Cd was obtained by capture of polarized thermal neutrons. The asymmetry coefficient A in the angular distribution of γ-rays (8.1–9.5 MeV) was measured to $(1.2 \pm 1.2)\ 10^{-4}$, indicating no violation of parity in nuclear forces. (auth)

51972 VECTOR DOMINANCE MODEL AND CHARGED PION PHOTOPRODUCTION SUM RULES. Hayashi, M. (Jagiellonian Univ., Krakow). Acta Phys. Pol., 36: No. 1, 53-7(July 1969).

It is shown that SU(3) × SU(3) symmetry with the vector dominance model (VDM) allows one to derive the photoproduction sum rules derived previously on the basis of the quark model and VDM. (auth)

51973 TAKING ACCOUNT OF SPACE-PARITY VIOLATION WHEN STUDYING T VIOLATION. Barshai, A. L.; Belyakov, V. A. Yadern. Fiz., 10: 392-6(Aug. 1969). (In Russian).

It is shown that the space-parity violation of nuclear states should be taken into account in experiments on the study of T

violation in nuclear electromagnetic transitions of mixed multipolarity with the experimental accuracy available. Expressions are obtained which describe the resonant absorption of the polarized γ emission in transitions which are the mixture of three multipolarities. The case of the mixture of M(1) – E(2) – E(1) is considered in detail. (auth)

51974 NONLINEAR REPRESENTATIONS OF THE GROUP SU(3) AND A MODEL OF SU(3)-SYMMETRY VIOLATION. Bolokhov, A. A.; Novozhilov, Yu. V. (Leningrad State Univ.). Yadern. Fiz., 10: 397-408(Aug. 1969). (In Russian).

The presented model treats the symmetry violation due to the terms of the type $\bar{B}\lambda_i B$ in the SU(3)-invariant Lagrangians, using nonlinear representations of the group SU(3). For the violation the nonlinear representation is realized on four scalar kaons κ with the transformation properties that are considered. The term in the Lagrangian that violates the SU(3)-symmetry is contained and the κ mesons mass is obtained from the PCVC condition. (auth)

51975 PARITY-FORBIDDEN DECAY OF THE 8.88-MeV ^{16}O STATE. Henley, E. M. (Univ. of Washington, Seattle); Keliher, T. E.; Yu, D. U. L. Contract AT(945-1)-1388. Phys. Rev. Lett., 23: 941-3(Oct. 20, 1969).

The decay rate of the 8.88-MeV state of ^{16}O is estimated with a parity-nonconserving force involving ρ exchange. It is pointed out that this decay can be of crucial importance for testing part of the nonleptonic weak interaction, because isospin conservation in the α decay limits the interaction responsible for the parity mixing in the initial state to the $\Delta I = 0$ part arising from the strangeness-nonchanging nonleptonic weak currents. (auth)

Applications (Strong)

Refer also to abstract 51957.

51976 (COO-427-95) BROKEN-SYMMETRY MASS FORMULAS FOR THE $J^P = \frac{1}{2}^+$ BARYON OCTET FROM S-MATRIX THEORY. Cushing, James T.; Pooch, Udo W. (Notre Dame Univ., Ind. Dept. of Physics). [1969]. 39p. Dep. CFSTI.

The S-matrix derivation of broken-symmetry mass formulas previously given for the $J^P = 0^-$ octet of pseudoscalar mesons is extended to the octet of $J^P = \frac{1}{2}^+$ baryons. Also the relation of crossing to the discrete symmetries of C and T (and of Bose statistics) is discussed. (auth)

51977 (IFVE-STF-69-12) BARYON REPRESENTATIONS OF THE SCHWINGER W(3) SYMMETRY GROUP. Masleev, N. N.; Tikhonin, F. F. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov, Institut Fiziki Vysokikh Energii). 1969. 14p. (In Russian). Dep. CFSTI (U. S. Sales Only).

The $\frac{3}{2}^+$-baryon states are classified according to the 45-dimensional representation of the group W(3). The relations among the masses of 45-plet in the first order of interaction, that violates the symmetry W(3) are derived. The trilinear Lagrangians of the interaction makes it possible to connect the constants of the hadron interaction. (auth)

51978 (JINR-P2-4581) SUPERFLUID QUARK MODEL. Malyuta, Yu. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1969. 22p. (In Russian). Dep. CFSTI (U. S. Sales Only).

A superfluid quark model based on the Sp(6) group is suggested (a superfluid model of the Flowers, Szpikowski and Ichimura nucleus based on the Sp(4) group is the prototype of this model). In the model mentioned the hadrons are described by eigenfunctions of the Hamiltonian of superconductive type, and the eigenvalues which determine their mass spectrum. The available experimental data agree well with the model predictions. (auth)

51979 CHIRAL U(3) x U(3)- AND SU(3) x SU(3)-DYNAMICS. Sabo, V. I. (Uzhgorod State Univ., USSR). Ukr. Fiz. Zh., 14: 1084-91(July 1969). (In Russian).

A series of experimentally checked consequences from chiral U(3) × U(3)- and SU(3) × SU(3)-dynamics is obtained. The principle of "minimal symmetry disturbance" is formulated and physically substantiated permitting the number of arbitrary parameters of symmetry disturbances to be reduced to minimum. Experimental consequences from this principle prove to be in good agreement with the available experimental data relative to strong interactions at low temperatures. A possibility is shown of solving the problem on realizability in the nature of one or another dynamics of those under consideration. (auth)

51980 SU(2) x SU(2) BREAKING AND THE CABIBBO ANGLE. Oakes, R. J. (Northwestern Univ., Evanston, Ill.). Phys. Lett., 29B: 683-5(Aug. 18, 1969).

In a recent investigation of the transformation properties under chiral SU(3) × SU(3) of the hadron energy density H(X) Gell-Mann, Oakes and Renner have assumed the form $H = \overline{H} - H_0\, CU_8$ where $\overline{H}$ is SU(3) × SU(3) invariant while U_0 and U_8 belong to the representation $(3^*,3) + (3,3^*)$ and have found the constant C to be near the value $-\sqrt{2}$, which corresponds to the limit in which the subgroup SU(2) × SU(2) remains an exact symmetry with the conservation of the axial-vector currents being realized through massless pions. The question of the SU(3) × SU(3) transformation properties of H(X) is pursued further and the deviations from the limiting case $C = -\sqrt{2}$ under specific assumptions regarding the origin of the breaking of SU(2) × SU(2) is investigated. The main assumption is that chiral SU(2) × SU(2) breaking in strong interactions ($C \neq -\sqrt{2}$, $m_\pi \neq 0$) and the nonconservation of strangeness in weak interactions (Cabibbo angle $\theta \neq 0$) derive from a common origin. It is found that all the small parameters $C + \sqrt{2}$, m_π/m_K and θ are simply related to each other and that the hadron energy density H(X) contains in addition a term U_3, belonging to the same $(3^*,3) + (3,3^*)$ representation of determined strength which also breaks SU(2) and thus contributes to certain mass shifts, e.g., $K^+ - K^0$, along with the usual electromagnetic interaction. Numerically the comparison with experiment is favorable lending support to the assumptions regarding the breaking of SU(2) × SU(2). (auth)

51981 EFFECTIVE STRONG-INTERACTION LAGRANGIAN WHICH IS INVARIANT WITH RESPECT TO THE EXPANDED-CALIBRATION SU(3) X SU(3)-GROUP OF SYMMETRY. Gendenshtein, L. E.; Tkach, V. I. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh., 14: 871-3(May 1969). (In Russian).

The inclusion of octets of vector and axial mesons into the scheme of a Lagrangian is described. The method of introducing calibration (compensating) fields is used in this case. An expression is given for the Lagrangian which includes the meson octet and a function of the meson fields. Another Lagrangian violates the expanded gauge invariance, but conserves invariance with respect to SU(3) × SU(3) having constant parameters. A third Lagrangian conserves invariance only with respect to unitary transformations. The total Lagrangian is the sum of the above three Lagrangians. The number of constants in the first Lagrangian can be decreased so as to obtain the ratios between the masses of vector and axial mesons, if the hypothesis of vector predominance is used. (TTT)

Field Theories

Quantum Field Theory

Refer also to abstracts 51850, 51876, 51907, 52013, and 52019.

51982 (NYO-1932(2)-157) SOME QUESTIONS CONCERNING ADIABATIC TRANSFORMATIONS. Wick, G. C. (European Organization for Nuclear Research, Geneva (Switzerland)). July 15, 1969. 11p. Dep. CFSTI.

Some results for the adiabatic theorem in quantum field theory are clarified and simplified. When a coupling constant is switched on exponentially $g(t) = g\, e^{\alpha t}$ the adiabatic limit is obtained for $\alpha \to 0+$. For finite α the state Ψ_g attained by the system at the time t = 0 satisfies a well-known differential equation with respect to the coupling constant g. This equation was previously obtained by means of a perturbation expansion in the interaction representation. It is pointed out that a much simpler derivation can be given without using a perturbation expansion. The limit $\alpha \to 0$ is mainly discussed. It is shown that this limit can be checked for an arbitrary order n by using the differential equations in g satisfied by the previously given state vectors Ψ_g and X_g. The relation between the adiabatic solution and the Rayleigh-Schrödinger perturbation series is thus completely established. (J.F.P.)

51983 (UCRL-19351) GLOSSARY FOR REGGE POLE THEORY. Jackson, J. D. (California Univ., Berkeley. Lawrence Radiation Lab.). Sept. 24, 1969. Contract W-7405-eng-48. 23p. Dep. CFSTI.

Part A contains a glossary for Regge pole theory for the use of readers of papers in this area of high energy theoretical physics. Part B contains definitions of invariant amplitudes and t-channel helicity amplitudes for meson-baryon elastic scattering and photoproduction of pions, as well as the connection between crossing symmetry and signature and a list of Regge trajectories. (auth)

51984 RETHINKING ON SPECIAL RELATIVITY THEORY. Mishra, Indu Shekhar (Fertilizer Corp. of India Ltd., Sindri). Technology (Sindri), 5: 328-9(Oct.-Dec. 1968).

It is argued that in the special relativity theory the concept that the velocity of light is the highest which practically no material

4)

particle can attain is untenable and misconceived. Considering the mass associated with the photon it can be clearly seen that a particle can exist even at a velocity greater than c without attaining infinite mass. (auth)

51985 GENERALIZED FEYNMAN AMPLITUDES. Speer, Eugene R. Princeton, N. J., Princeton University Press, 1969. 125p. $3.50.

Renormalization in the context of Lagrangian quantum field theory is reviewed, with emphasis on two points: the Bogolyubov-Parasiuk definition of the renormalized amplitude of an arbitrary Feynman graph, including some generalizations of the rigorous work of Hepp, and a discussion of the implementation of this renormalization by counter terms in an arbitrary interaction Lagrangian. A new quantity called a generalized Feynman amplitude is then defined. It depends analytically on complex parameters $\lambda_1, \ldots, \lambda_L$, and these analytic properties may be used to define renormalized Feynman amplitudes in a new way; the method is shown to be equivalent to that of Bogolyubov, Parasiuk, and Hepp. The generalized Feynman amplitude depends on other parameters also; when these take on certain values, it is equal to the Feynman amplitudes for various graphs (aside from problems of renormalization, which are handled via the λ dependence). The generalized amplitude thus interpolates the Feynman amplitude between different graphs. Some partial results are obtained which exploit this interpolation to give an integral representation for a sum of Feynman amplitudes. (auth)

51986 GREEN'S FUNCTIONS IN THEORIES WITH NON-ABELIAN GAUGE GROUP. Khriplovich, I. B. (Inst. of Nuclear Physics, Novosibirsk, USSR). Yadern. Fiz., 10: 409-24(Aug. 1969). (In Russian).

The Yang–Mills field in the radiative gauge is considered. Its Hamiltonian as a function of independent canonic variables is written as the infinite series on the coupling constant. Thus when using the diagram technique, the graphs with no analogs in quantum electrodynamics appear. It is shown that the representation of the interaction Hamiltonian as N-product which is unnecessary in spinor electrodynamics, is not allowed in scalar electrodynamics and in the Yang–Mills theory. The general structure of the Green function of the Yang–Mills field is considered. The Green function is then calculated in the second order of the perturbation theory. It is shown that in the perturbation theory the mass can appear neither in the Yang–Mills field nor in the gravitational one. Off the terms of the perturbation theory the appearance of the mass in these fields implies in any case the more strict conditions than the appearance of the photon mass. It is shown how the number of the degrees of freedom of the vector field in radiative gauge increases from two up to three when the mass appears in it. (auth)

51987 HIGH ENERGY BEHAVIOR IN QUANTUM ELECTRODYNAMICS. Wu, T. T. (Harvard Univ., Cambridge, Mass.). pp 69-82 of Proceedings of the 1969 Regge Cut Conference, Madison, Wisconsin, April 23-25, 1969. Part I. Fishbane, Paul M.; Simmons, L. M. Jr. (eds.). Madison, Wis., University of Wisconson, 1969.

See CONF-690430-(Pt.1).

Some recent results on high-energy behavior in quantum electrodynamics are discussed. A photon mass is included in the discussion since quantum electrodynamics has peculiarities due to the massless nature of the photon or long-range Coulomb field, while there is no massless hadron. Electron-electron scattering, Compton scattering, impact factors, Delbruck scattering, electron inelastic scattering, and the electromagnetic form factor are considered. (J.F.P.)

51988 KERNEL INTEGRAL FORMULAS FOR THE CANONICAL COMMUTATION RELATIONS OF QUANTUM FIELDS. I. REPRESENTATIONS WITH CYCLIC FIELD. Hegerfeldt, Gerhard C. (Univ., Marburg, Ger.). J. Math. Phys. (N. Y.), 10: 1681-98(Sept. 1969).

The kernel or group integral for the canonical commutation relations introduced by Klauder and McKenna and its generalizations is investigated. For the finite case the kernel integral formula was proven by means of the Schrödinger representation. Motivated by the close similarity of the Schrödinger representation to the form of a general representation with cyclic field, these representations are examined with respect to kernel integral formulas. A general criterion is derived in which the dimensionality of the test function space does not enter, i.e., it is independent of the number of degrees of freedom. In this way the finite and infinite case can be treated on equal footing. The criterion contains as special cases the kernel integral formulas of Klauder and McKenna for finitely many degrees of freedom and for direct- (or tensor-) product representations of fields. For partial tensor-product representations a somewhat modified formula is obtained. After these applications, a considerably sharpened form of the criterion is derived in which only the vacuum expectation functional enters. Under a certain cyclicity assumption it is shown that the validity of a kernel integral for just some cyclic vector implies its validity for all vectors. It is further shown that the basis-independent integral defined by a supremum over all bases of the test function space V can be replaced by an ordinary limit over a kind of diagonal sequence through finite-dimensional subspaces of V. In the last section a representation is constructed which possesses a cyclic field but does not fulfill a kernel integral formula; this is an instructive illustration of a general theorem to be proved. (auth)

51989 BARE ELECTRON AND MUON VALUES ASSOCIATED WITH AN INVARIANT CUT-OFF IN QUANTUM ELECTRODYNAMICS. Rosen, G. (Drexel Inst. of Tech., Philadelphia). Nuovo Cim., Lett., 2: 561-2(Oct. 11, 1969).

It is suggested that the renormalization procedure in quantum electrodynamics should be performed with a finite empirical physical value for the invariant cut-off and therefore with finite values for the bare masses of the electron and meson (μ). It is found that boundary conditions on the invariant cut-off and the special form the formula for the relation between the observable dressed mass and bare mass for either charged lepton to first order are sufficient to fix the primary meson (μ)–electron bare-mass ratio to an accuracy of one part in 20,000, and the electron dressed mass to bare mass ratio, and the meson (μ) dressed mass to bare mass ratio to one part in 300. (J.F.P.)

51990 CLASSICAL DESCRIPTIONS OF MOTION. THE DYNAMICS OF PARTICLE TRAJECTORIES, RIGID ROTATIONS, AND ELASTIC WAVES. Konopinski, Emil Jan. A Series of Books in Physics. San Francisco, W. H. Freeman and Company, 1969. 516p. $15.00.

The discussion covers the kinematics of a particle, elements of particle dynamics, linear motions, orbital motions of a particle, the interactions of two particles, many-particle systems, descriptions in configuration spaces, and descriptions in phase spaces. Also covered are rotations and frame transformations, rigid body dynamics and eigenvector problems, coupled oscillations, oscillations in a linear continuum, surface vibrations, spatial waves, and Lagrangians and energies in continua. Applications are made to mu-mesic atoms, quadrupolar gravitational effects, proton–proton scattering, phase space spectra, the benzene molecule, spin matrices, and complementarity in wave packets. (J.F.P.)

51991 RELATIVISTIC MOTION OF PARTICLES IN A SCALAR FIELD. Mirianashvili, M. M. (Univ. of Tbilisi, USSR). Wiss. Z. Friedrich-Schiller-Univ., Jena, Math.-Naturwiss. Reihe, 17: 181-3(1968). (In Russian).

The development of the non-relativistic equation of motion $m_0 dv/dt = -\text{grad } W$, with the effective potential W for a test particle in a spherically symmetric field, used by Szamosi and Marx is examined critically. A 4-dimensional treatment indicates that no collision sphere can exist for finite radii; further, hypothetical states of the particle where it displays negative mass do not have to be assumed. The studies of Werle on this problem appear also to be incorrect in the treatment of the spherically symmetric scalar field with the relativistic Hamilton-Jacobi equation, for a definite term is claimed to have been incorrectly ignored. A proper derivation is supplied in place of the incorrect one. (BBB)

Gravitation and General Relativity

Refer also to abstracts 51356 and 52029.

51992 (IFVE-STF-69-6) ENERGY-MOMENTUM OF A CLOSED STATIC SYSTEM IN THE THEORY OF GRAVITATION, E = 0. Folomeshkin, V. N. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1968. 7p. (In Russian). Dep. CFSTI (U. S. Sales Only).

It is shown that the standard expression for the total mass M of a closed static system in the form of the volume integral of canonical energy-momentum complex using the covariant quantity R as Lagrangian leads to the equality $M = \frac{1}{2} M_s$, where M_s - Schwarzschild mass of the system. It follows that either the expression for the complex is inconsistent with the field equations or the "total" mass of the system is different from Schwarzschild mass, or M = 0. There are some ideas given here that favor the possibility of M = 0. (auth)

51993 (NYO-2262-TA-208) LIGHT PROPAGATION IN A TIME DEPENDENT GRAVITATIONAL FIELD. Westervelt, P. J. (Brown Univ., Providence, R. I. Dept. of Physics). [1969]. 3p. (CONF-690713-1). Dep. CFSTI.

From Seminar on Relativity and Gravitation, Haifa, Israel.

An analysis for light propagation in the time-dependent field of the sun is applied to the photon. From this an additional general relativistic Doppler correction is found. (J.F.P.)

51994 (NYO-2262-TA-209) GRAVITATIONAL LIGHT-LIGHT AND LIGHT-PARTICLE SCATTERING: COMPARISON BETWEEN THE CLASSICAL (GENERAL RELATIVISTIC) AND QUANTUM FIELD THEORETIC RESULTS. Westervelt, Peter J.; Karr, Lawrence F. (Brown Univ., Providence, R. I. Dept. of Physics). June 30, 1969. 10p. Dep. CFSTI.

The classical scattering by a moving photon of negligible spatial extent is calculated for light-light and light-particle interactions in the cms frame of the particles. Cross sections for a steady pencil of light, the quantum light-light scattering cross section and the correct light-scalar particle scattering cross section based on the lowest order matrix elements for this process are given, and a comparison of the quantized and classical results in the domain of classical scattering are presented. (J.F.P.)

51995 OBSERVED EFFECTS IN RELATIVISTIC TENSOR THEORIES OF GRAVITATION IN PLANE SPACE. Naida, O. N. Dokl. Akad. Nauk SSSR, 186: 560-3(1969). (In Russian).

It is shown that the theory of gravitation, in which the principle of equivalence, and particularly the relativistic tensor theories of gravitation in plane space, are disrupted in some way may be made to agree with the available experimental data only, if in these theories along with the Newtonian gravitational potential a gravitational potential is used which depends on the distance as $r^{-1} \exp(rR^{-1})$. Here the radius of action R is not greater than 10^9 light years, which is one-tenth of the radius of the visible part of the universe. The action functional of a system of N material points, which interact through gravitational and electromagnetic fields, is defined and analyzed. From relativistic measurements it can be deduced that the Neiman gravitational potential with an action radius R is at least an order of magnitude less than the size of the visible part of the universe. (TTT)

51996 NOTE ON THE EQUATIONS OF MOTION OF A PARTICLE IN GENERAL RELATIVITY. Dadhich, N. K. (Univ. of Poona). Proc. Nat. Inst. Sci. India, Part A, 135: 343-50(Mar. 1969).

A variation principle of the form $\delta \int m\, ds = 0$ is considered for a curved space-time corresponding to an unspecified gravitational situation. The equation of motion and consequences following from it as considered are believed not considered so far in this form elsewhere. m is treated as a scalar function of x^i, v^i and the equations of motion can be considered as providing the effect of a nongravitational field on the background of any specified gravitational field. (auth)

51997 MOST GENERAL LINEAR THEORY OF GRAVITATION. Nachtmann, Otto; Schmidle, Harald; Sexl, Roman U. (Univ., Vienna). Commun. Math. Phys., 13: 254-6(Sept. 5, 1969).

The most general field theory of gravitation is analyzed both group theoretically as well as physically. The field equations are solved by means of an algebraic method and it is found that any field theory of gravitation contains only one essential parameter which is correlated to the spin-0 content of the field. Further it turns out that any theory of gravitation must contain a nonvanishing spin-0 part, but general relativity is distinguished by the fact that its spin-0 component cannot be radiated. (auth)

51998 POLARIZATION OF LIGHT IN GENERAL RELATIVITY. Roddier, Pierre (Departement de Mathematiques Pures, Clermont-Ferrand, France). Compt. Rend., Ser. A, 269: 46-8 (July 7, 1969). (In French).

After giving the definition of elliptical and rectilinear polarization in general relativity for an electromagnetic field, the permanence of such a field is shown, and the rotation of the light polarization plane in Schwarzschild space is calculated. (tr-auth)

51999 SURFACE DISTRIBUTION OF MATTER IN GENERAL RELATIVITY. Cantoni, Vittorio. Atti Accad. Naz. Lincei, Rend., Cl. Sci. Fis., Mat. Natur., 45: 22-31(July-Aug. 1968). (In Italian).

The matching conditions across a hypersurface representing the evolution of a layer of matter are derived from Einstein's equations and from Lichnerowicz' matching conditions by a limiting process which consists in letting the thickness of a volume distribution of dust tend to zero, and are shown to give, in the newtonian approximation, the classical matching conditions for the derivatives of the newtonian potential across a layer of matter. The point of view adopted is distinct from the ones adopted by Lanczos and Papapetrou & Treder in dealing with the same problem. (auth)

52000 MORE TESTS OF GENERAL RELATIVITY. Keswani, G. H. Nature (London), 223: 1264-5(Sept. 20, 1969).

It is stated that experiments where atomic clocks have been flown over long distances and brought back for comparison after some months have yielded relativistic corrections of only about 2 μs, the order of the random errors expected. Experiments are suggested to detect much larger cumulative first order effects due to gravity and the rotation of the earth. Terrestrial experiments are to be preferred, since they can be more easily repeated and controlled. Preliminary measurements of the time of travel of radar pulses reflected from planets appear to indicate that the velocity of the pulses diminishes with the gravity field, as required by general relativity. Assuming a radially symmetric distribution for the earth's mass, a metric of space-time exterior to the earth is derived from the vacuum field equation. The variation of the time measure in the reference system chosen during the orbital motion of the earth in the gravity field of the sun is assumed to be the same for all terrestrial clocks and to be superimposed on the effects of the earth. Clocks stationary relative to the earth are considered. The effects of variations in altitude and longitude are comparable, and although small, over a period of, say, about a year they will be substantial compared with random errors in the clocks. Variations in density and other factors affecting the gravity field are considered, together with the nonsphericity of the earth. The world lines of two clocks, one of which remains stationary and the other is transported to a suitable location with a different gravitational potential and/or latitude on the earth, and brought back for comparison with the stationary clock after 3×10^7s, are examined, from which two such clock experiments are suggested. Experimental verification of the interior metric to terms of the first order is also discussed. The effect of the interior metric on clocks can be found by taking them into mines; time differences of 6.5 to 10 μs in 1 yr are to be expected in deep mines. The exterior and interior Schwarzschild metrics of the general theory of relativity may thus be tested for the gravity and rotational field of the earth. Such tests, however, do not prove the theory; they only enhance its credibility. (UK)

52001 CONSERVED QUANTITIES OF NEWMAN AND PENROSE. Robinson, David C. (Syracuse Univ., N. Y.). J. Math. Phys. (N. Y.), 10: 1745-53(Sept. 1969).

Green's theorem is used to obtain the Newman-Penrose constants in flat and asymptotically flat space-time and to investigate the invariant transformations which these quantities generate. The zero-rest-mass free fields and the coupled Einstein-Maxwell fields are considered and the relation of this approach to Noether's theorems is discussed. (auth)

52002 CONSERVED QUANTITIES IN THE EINSTEIN-MAXWELL THEORY. Exton, Albert R. (Univ. of Pittsburgh); Newman, Ezra T.; Penrose, Roger. J. Math. Phys. (N. Y.), 10: 1566-70(Sept. 1969).

It is shown that the 10 gravitationally-conserved quantities defined in asymptotically flat, empty, space-times are, when suitably modified, also conserved in asymptotically flat Einstein-Maxwell space-times. Furthermore, the implied selection rules for transitions between stationary Einstein-Maxwell states are the same as those in the pure gravitational case. (auth)

52003 NONLINEAR ELECTRODYNAMICS AND GENERAL RELATIVITY. Pellicer, R.; Torrence, R. J. (Instituto Politecnico Nacional, Mexico City). J. Math. Phys. (N. Y.), 10: 1718-23(Sept. 1969).

A generalization of Born-Infeld nonlinear electrodynamics, due to Plebanski, is reformulated in the context of general relativity theory. A class of nonsingular, static, spherically symmetric solutions of the modified Einstein-Maxwell equations is given, corresponding to a point-charge source. The metric tensors of these solutions are shown to approach the Riesner-Nordstrom metric tensor at large distances from the source, if one makes the proper identification of mass. (auth)

52004 ON FLAT GRAVITATION AS A USEFUL MODEL THEORY. II. Efinger, H. J. (Dublin Inst. for Advanced Studies, Univ. of Georgia, Athens). Physica, 44: 9-18(Sept. 8, 1969).

In a discussion on flat gravitation model theories the problem of gravitational interactions is studied at the level of relativistic quantum theory. Exact solutions can be obtained, neglecting the self-field of particles. In a generalization of the theory, considering that the gravitational field is of finite range, a new mass unit for elementary particles is introduced. (auth)

52005 GRAVITATION AND QUANTUM MECHANICS OF MACROSCOPIC OBJECTS. Karolyhazy, F. (Eoetvoes Univ., Budapest). Wiss. Z. Friedrich-Schiller-Univ., Jena, Math.-Naturwiss. Reihe, 17: 223-7(1968).

The problem of the reduction of the wave function in quantum theory is treated from a new viewpoint. By combining Heisenberg's uncertainty relations with gravitation, quantitative limitations on

the sharpness of the structure of space-time are derived. The resulting uncertainty in space-time structure is incorporated into the equations for the propagation of the quantum mechanical wave amplitudes. It develops that an initially pure wave function in time generally turns into a mixture. A single pure wave function survives only as long as it corresponds to a sufficiently small spread in the position of any massive part of the system under investigation. Quantitative relations between the mass and the maximum coherent spread in the center-of-mass wave function of a single body are found. The concepts of classical mechanics are already used when space-time is set up as the basis of the quantum mechanical formalism. The motions of macroscopic bodies, as well as the gravitational curvature of space-time which they produce, are rendered classical by the theory. The extremely small smearing introduced makes the relation between microscopic bodies and macroscopic space-time consistent. It does not affect the open questions concerning space-time and high-energy phenomena. (BBB)

52006 INFINITE PLANES IN GENERAL RELATIVITY. Kuchar, Karel (Charles Univ., Prague). Wiss. Z. Friedrich-Schiller-Univ., Jena, Math.-Naturwiss. Reihe, 17: 189-90(1968).

The gravitational field of a massive plate, and the gravitational field of a system formed by two such plates of equal mass, present a number of difficulties to the general theory of relativity; analogies with Newtonian physics and the unexpected differences which arise in studying infinite planes in Einstein's theory of gravitation are reviewed. The massive plate is represented as an infinitely thin shell of ideal fluid. Expected symmetries together with the Einstein gravitational law in vacuum lead to the line-element studied by Petrov. The constant a of the exterior field is determined by the rest surface density σ of the mass on the plate. In distinction to the Newtonian physics, the tension is necessary to maintain this static solution. All space-like geodesics sent out perpendicularly to the plate meet finally at the same point. The solution due to two identical plates at a finite proper distance gives a static solution, though the plates are not prevented by normal forces from falling together. This is probably due to the fact that the strong tension which must exist in the plates in order that the solution be consistent is equivalent to an effectively negative gravitational mass. If the tension in both plates is suddenly relieved, the plates fall to each other through the flat space-time between them, dragging the curved space-time behind them. The last instance is interesting also as an example of a collapsing system emitting no gravitational radiation. (BBB)

52007 ON SOME FUNDAMENTAL CONCEPTS OF GENERAL RELATIVISTIC CONTINUUM MECHANICS AND THEIR SIGNIFICANCE FOR BASIC QUESTIONS OF MEANING OF GENERAL RELATIVITY THEORY. Schmutzer, Ernst (Theoretisch-Physikalisches Institut, Jena, Ger.). Wiss. Z. Friedrich-Schiller-Univ., Jena, Math.-Naturwiss. Reihe, 17: 199-203(1968). (In German).

Helmholtz's method for non-relativistic continuum mechanics is recapitulated; his method of deriving the expressions for the strain and rotation tensor by decomposition of the derivative of the displacement is then generalized for general relativistic continuum mechanics. The relativistic expressions obtained agree in part with those introduced by Synge. Specialization for the rest system of the medium leads to quantities which behave like tensors with respect to reference-invariant transformations. Because notions of matter do not enter into them, they have an independent meaning only determined by the metric. They may be possibly interpreted as absolute (in some respect) quantities referring to the locally fixed Minkowski space. (BBB)

52008 ON FLAT GRAVITATION AS A USEFUL MODEL THEORY. I. Efinger, H. J. (Dublin Inst. for Advanced Studies, Univ. of Georgia, Athens). Physica, 44: 1-8(Sept. 8, 1969).

It is noteworthy that a conformally-flat gravitation theory of Einstein–Fokker type obeys field equations which can easily be derived from two basic assumptions: they contain Newton's theory as a first approximation, and result from an action principle. Furthermore, it is shown that one obtains nonlinear Schiff-type equations, for which exact solutions are known, by introducing a cosmologic member. (auth)

Scattering Theory

Refer also to abstracts 51869, 51870, 51983, and 51985.

52009 (IC-67/9(Pt.1)(Amend.)) PARTIAL WAVE ANALYSIS. Strathdee, J.; Boyce, J. F.; Delbourgo, R.; Salam, Abdus (International Centre for Theoretical Physics, Trieste (Italy)). Feb. 1967; Amended May 1967. 89p. Dep. CFSTI (U. S. Sales Only).

A review of partial wave analysis is given on the basis of the group theoretical approach. The unitary representations of the Poincare group, classification of irreducible representations, reduction of the direct product, analytical properties of little group representations, improper transformations, and partial wave analysis of S-matrix elements are covered. (J.F.P.)

52010 (JINR-P2-4565) STOCHASTIC INTERPRETATION OF THE ELASTIC SCATTERING PROCESS AT HIGH ENERGIES IN CASE OF SMEARED WAVE PACKETS. Shurgaya, A. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1969. 16p. (In Russian). Dep. CFSTI (U. S. Sales Only).

It is supposed that the momentum distribution in the intermediate states of the elastic scattering is described by a stable law with the characteristic $0 < a < 2$. The contribution of the highest intermediate states to the imaginary part of the scattering amplitude is calculated. It is shown that the scattering amplitude in this case is a degree function of the momentum transfer. (auth)

52011 (MATSCIENCE-47) LECTURES ON FUNCTIONAL FORMULATION IN S-MATRIX THEORY. Rzewuski, J. (Institute of Mathematical Sciences, Madras (India)). [1966]. 286p. DIMSI $1.00.

N-point functions or the generating functionals for these functions for elementary particle interactions are studied based on the principles of relativistic invariance and microscopic causality. Functional matrices and the corresponding calculus with respect to a special type of functional matrices found in S-matrix theory, the S-matrix, the interaction functional, generalizations of the functional formalism to charged spin-0 and -½ particles and to photons, functional integration and related problems, a statement of the theory in terms of functional integrals and some explicit calculations, and lastly a mathematical device by means of which the divergent quantities may be represented as the limits of well-defined quantities are covered. (J.F.P.)

52012 (NYO-1932(2)-151) THREE-BODY CALCULATIONS WITH LOCAL POTENTIALS. Brayshaw, D. D. (Columbia Univ., New York). July 1969. 9p. (CONF-690710-2). Dep. CFSTI.

From International Conference on the Three-Body Problem, Birmingham, England.

A two-term separable approximation to the two-particle t-matrix is developed which preserves exact behavior at each bound state or resonance pole. While introducing no additional singularities, the approximation also produces the exact right-hand cut. This separable approximation is applied to the three-particle scattering problem with local potentials, and numerical results are obtained for the three-body binding energy in the case of the Yukawa and exponential potentials. These results are shown to be in good agreement with those recently published by Humberston, Hall and Osborn. (auth)

52013 BOUND-STATE SOLUTIONS TO THE BETHE–SALPETER EQUATION OF THE WICK–CUTKOSKY MODEL. Mueller, Harald J. W. (American Univ., Beirut). Z. Phys., 227: 340-3(1969).

A perturbation method is used for solving the Bethe–Salpeter equation of the Wick–Cutkosky model in the case of unequal masses. The explicit expansions obtained demonstrate clearly the intersection of the curves "coupling constant vs. energy" at a characteristic energy depending on the difference between the masses of the particles. (auth)

52014 UNSTABLE PARTICLES, TWO-BODY INELASTIC UNITARITY, AND VENEZIANO'S MODEL. Bali, N. F.; Coon, Darryl D.; Dash, Jan W. (Univ. of Washington, Seattle). Phys. Rev. Lett., 23: 900-3(Oct. 13, 1969).

An integral over the Veneziano amplitude which introduces singularities of two-body inelastic unitarity in the amplitude is proposed. The model provides a framework for a unified treatment of quantization conditions, the stability of particles, the Pomeranchuk singularity, and decay of particles by pion emission. (auth)

52015 THEORY OF THE OPTICAL POTENTIAL. Foldy, L. L. (Case-Western Reserve Univ., Cleveland); Walecka, J. D. Contracts F44620-68-C-0075; AT(11-1)-1573. Ann. Phys. (N. Y.), 54: 447-504(Oct. 1, 1969).

Elastic scattering of a projectile by a complex many-body system is considered. The incident energy is assumed high enough so that closure may be used on the target, and the problem is reduced to computing the target ground-state expectation value of the scattering amplitude from A fixed scattering centers. This A-body scattering amplitude is solved exactly, using a model of a sum of separable potentials (the approach is extended to a more general class of potentials). The exact amplitude exhibits many interesting

properties. Then a multiple scattering expansion is made of this amplitude, and simultaneously, an expansion of the ground-state density in terms of single-particle densities, two-particle densities, and so on. By comparing the resulting multiple scattering amplitude term by term with the scattering series from a one-particle Schrödinger equation for the projectile, an equivalent, or optical potential can be identified. A lowest-order optical potential is identified stating precisely under what conditions it will generate the correct scattering amplitude. By summing additional classes of multiple scattering graphs, modifications due to two-particle correlations and multiply struck target particles ("local field" corrections) are included. The limiting cases of S-wave scattering and very high energy projectiles are discussed in detail. Some calculations of the high-energy optical potential based on more realistic elementary-particle scattering amplitudes are presented. The effects of spin and isospin are discussed, and center-of-mass motion is considered. (auth)

52016 THE SIX-POINT GREEN FUNCTION AND THE APPLICATION OF FADDEEV'S THEORY TO THE MANY-BODY PROBLEM. Ethofer, S.; Schuck, P. (Technische Hochschule, Munich). Z. Phys., 228: 264-85(1969).

Integral equations for the 6-point Green function are established and a Faddeev-like part extracted. A qualitative solution of the integral equation is given in the sense of the renormalized RPA. The connection of the mass operator M, K, and T matrices with "higher" point Green functions is discussed. (auth)

52017 DEFINITION AND INTERPRETATION OF MULTIPATH OPERATORS IN RELATIVISTIC SCATTERING THEORY. II. Genz, Henning (Univ., Munich). Acta Phys. Aust., 28: 177-215(1968). (In German).

Multipath operators in the relativistic scattering theory for particles and antiparticles are discussed. Topics discussed include the multipath concept, invariant amplitude and crossing relations, two-path functions in local space, discrete transformations, and unitarity of the physical amplitude. Bound states were not considered. 33 references. (C.E.S.)

52018 PROCEEDINGS OF THE 1969 REGGE CUT CONFERENCE, MADISON, WISCONSIN, APRIL 23-25, 1969. PART I. Fishbane, Paul M.; Simmons, L. M. Jr. (eds.). Madison, Wis., University of Wisconsin, 1969. 132p. (CONF-690430-(Pt.1)).

Part I of the conference included eight papers. Separate abstracts were prepared for each paper. (J.F.P.)

For abstracts of individual papers see: 51914, 51959, 51987, and 52019-52023.

52019 INTRODUCTION TO FEYNMAN MODEL TECHNIQUES. Risk, Clifford (Univ. of Michigan, Ann Arbor). pp 30-40 of Proceedings of the 1969 Regge Cut Conference, Madison, Wisconsin, April 23-25, 1969. Part I. Fishbane, Paul M.; Simmons, L. M. Jr. (eds.). Madison, Wis., University of Wisconsin, 1969.
See CONF-690430-(Pt.1).

A review of results derived in the study of the high-energy behavior of scattering amplitudes that are defined by sums of Feynman diagrams is presented. Techniques for evaluating asymptotic behavior, classes of Feynman diagrams, models for scattering amplitudes, and the absorption model from Feynman diagrams are included. (J.F.P.)

52020 ITERATIONS OF REGGE CUTS. Polkinghorne, J. C. (Cambridge Univ., Eng.). pp 41-50 of Proceedings of the 1969 Regge Cut Conference, Madison, Wisconsin, April 23-25, 1969. Part I. Fishbane, Paul M.; Simmons, L. M. Jr. (eds.). Madison, Wis., University of Wisconsin, 1969.
See CONF-690430-(Pt.1).

An adequate model for a Regge cut is constructed, which is wholly consistent with t-channel unitarity and successfully removes the Gribov-Pomeranchuk essential singularity. (J.F.P.)

52021 THE THREE-REGGEON VERTEX. Landshoff, P. V. (Cambridge Univ., Eng.). pp 61-8 of Proceedings of the 1969 Regge Cut Conference, Madison, Wisconsin, April 23-25, 1969. Part I. Fishbane, Paul M.; Simmons, L. M. Jr. (eds.). Madison, Wis., University of Wisconsin, 1969.
See CONF-690430-(Pt.1).

Previous ideas of a two-particle-Reggeon coupling function are extended to a three-Reggeon coupling function. The effects of signature are omitted. The properties of this coupling function are studied by considering the Mellin transform of the six-point function. It is noted that the structure for the three-Reggeon coupling function is verified by perturbation theory models and in the extension of the Veneziano model to the six-point function. (J.F.P.)

52022 REGGE CUT FROM A NON-PLANAR DUALITY AMPLITUDE. Kikkawa, K. (Univ. of Wisconsin, Madison). pp 83-95 of Proceedings of the 1969 Regge Cut Conference, Madison, Wisconsin, April 23-25, 1969. Part I. Fishbane, Paul M.; Simmons, L. M. Jr. (eds.). Madison, Wis., University of Wisconsin, 1969.
See CONF-690430-(Pt.1).

The 1-plane analyticity of simple nonplanar amplitudes is investigated. The question of whether the nonresonant background scattering gives the Regge cut asymptotically within the framework is considered. The treatment gives a simple and general Regge cut calculus in the arbitrary Reggeon-exchange diagram. Essentially nonplanar diagrams with one loop are considered. The Veneziano model or its tree diagram generalization is constructed in such a way that two or more adjacent particles are coupled to common Reggeons or a tower of resonances in their channel while nonadjacent particles are not. The diagrams and their relations with duality are discussed. (J.F.P.)

52023 ABSORPTIVE CUTS FROM FEYNMAN DIAGRAMS. Henyey, Frank S. (Univ. of Michigan, Ann Arbor). pp 96-108 of Proceedings of the 1969 Regge Cut Conference, Madison, Wisconsin, April 23-25, 1969. Part I. Fishbane, Paul M.; Simmons, L. M. Jr. (eds.). Madison, Wis., University of Wisconsin, 1969.
See CONF-690430-(Pt.1).

The relation between the sums of Feynman diagrams and the absorbed Regge pole model approaches for the study of Regge cuts is investigated. (J.F.P.)

52024 PROCEEDINGS OF THE 1969 REGGE CUT CONFERENCE, MADISON, WISCONSIN, APRIL 23-25, 1969. PART II. Fishbane, Paul M.; Simmons, L. M. Jr. (eds.). Madison, Wis., University of Wisconsin, 1969. 115p. (CONF-690430-(Pt.2)).

Part II of the conference included 11 papers. Separate abstracts were prepared for each paper. (J.F.P.)

For abstracts of individual papers see: 51896, 51915, 51916, 51930, 51940-51943, and 51960-51962.

52025 SOME REMARKS ON SCATTERING BY SINGULAR POTENTIALS. Aly, H. H. (Southern Illinois Univ., Edwardsville); Mueller, H. J. W.; Vahedi-Faridi, N. Nuovo Cim., Lett., 2: 485-94(Oct. 1, 1969).

A new solution of the modified Mathieu equation is derived and its symmetry properties used to define other solutions. Their connection formulas and the S-matrix are derived, and various previous results are correlated. Regge poles in the high- and low-energy regions are discussed, and the relation between low- and high-energy auxiliary parameters is explicitly stated. The results permit generalization to the potential $1/r^m$, $m \neq 4$. (J.F.P.)

52026 A REMARK ON THE ANALYTICITY PROPERTY IN POTENTIAL SCATTERING. Cheung, F. (Univ. of Notre Dame, Ind.). Nuovo Cim., Lett., 2: 471-2(Oct. 1, 1969).

A result for the analyticity property in potential scattering that is analogous to the Lehmann result in field theory is shown. In both cases the scattering amplitude at any given physical energy is analytic in the cos θ plane inside a certain ellipse with foci ± 1 and semi-major axis $z_0(E)$, while the imaginary part at the same given energy is analytic inside a confocal ellipse but with a larger semi-major axis given by $z_1(E) = 2z_0^2(E) - 1$. However, the semi-major axis in the potential scattering has a much milder energy dependence than that in the field theoretical case. (J.F.P.)

52027 THE GREEN-FUNCTION METHOD FOR THE SCATTERING EQUATION IN A BOUNDED REGION. Minelli, T. A. (Univ., Padua); Zardi, F. Nuovo Cim., Lett., 2: 461-5(Oct. 1, 1969).

An alternative approach to the Bloch theory approach for the generalization of the scattering equation in a bounded region is given. The Green function method is used without explicitly referring to the previous symbolic boundary condition operators. While only one-channel S-wave problems are studied, the generality of the proposed method is evident. (J.F.P.)

52028 EQUIVALENCE BETWEEN VELOCITY-DEPENDENT POTENTIALS AND STATIC POTENTIALS. Calogero, F. (Univ., Rome. Istituto Nazionale di Fisica Nucleare, Rome). Nuovo Cim., Lett., 2: 553-60(Oct. 11, 1969).

The problem of two particles interacting through the potential $U(r) + \frac{1}{2}(p^2v_1(r) + v_1(r)p^2 + pv_2(r)p$, where $r = r_1 - r_2$, $p = \frac{1}{2}(p_1 - p_2) = -i\Delta_r$ is considered. A complete equivalence is established between velocity-dependent and static (but energy-dependent) potentials. The one-channel problem is considered, but the main results are valid for multichannel problems such as the nucleon-nucleon case. (J.F.P.)

52029 QUASICLASSICAL SCATTERING IN A CENTRAL-SYMMETRIC FIELD. Khudyakov, S. V. Zh. Eksp. Teor. Fiz., 57: 927-37(July 1969). (In Russian).

The scattering amplitude in the quasiclassical approximation is investigated for the case when the limiting classical scattering angle is not small. In the case of a single caustic a unified formula is deduced which yields the cross section in the classically accessible as well as inaccessible regions. (auth)

Particle Accelerators

Refer also to abstracts 50143, 50177, 50178, 50182, 50211, 51868–51870, 51903, 52108, and 52109.

52030 (AEEW-M-896) A DESCRIPTION OF THE EQUIPMENT FOR TIME-OF-FLIGHT SPECTRUM MEASUREMENTS ON THE FAST REACTOR ZEBRA. Gibson, I. H.; Jakeman, D.; Sanders, J. E. (Atomic Energy Establishment, Winfrith (England)). May 1969. 19p. Dep. CFSTI (U. S. Sales Only). UK 3s. 0d.

The pulsed source for the time-of-flight equipment consists of 14 MeV S-band linear electron accelerator, drift tube, and water-cooled uranium-molybdenum alloy target installed on the ZEBRA lattice. Neutrons are extracted via a probe tube inserted into the core and an evacuated flight tube with counting stations at 50, 97, and 200 m from the core center. Two types of neutron detector are described and also the Ferranti Argus 500 on-line computer which is used for data collection. The equipment is used for measuring the neutron energy spectra from the lowest energies up to about 1 MeV. (auth)

52031 (CEA-CONF-1285) ON THE FUTURE SUPPLY OF MAGNETS FOR ALIGNMENT OF THE SYNCHROTRON. Lods, A. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). [1967]. 12p. (In French). (CONF-690324-1). Dep. CFSTI (U. S. Sales Only).

From Conferences on Magnets for Application to Nuclear Physics and Their Equipment for Energization, Paris, France.

After a brief review of the general characteristics of existing power supplies, an examination is made, in the light of new development of these power supplies. In particular the problems related to groups of rotary converters are recalled, from the use of thyristors to the filtering of continuous voltage. Finally a rapid examination is made of the incidence on the dimensions of the power supply of the selection of a superconducting magnet. (tr-auth)

52032 (CEA-CONF-1286) COLLECTIVE ION ACCELERATOR AND HEAVY IONS. Bruck, H. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). [1969]. 8p. (In French). (CONF-690314-4). Dep. CFSTI (U. S. Sales Only).

From Conference on the Physics and Production of Heavy Ions, La Plagne, France.

The entrainment of ions by the collective field of a cloud of accelerated electrons is designated as collective ion acceleration. The application of this concept to the acceleration of heavy ions is considered. The characteristics of a heavy ion collective accelerator are derived. (J.S.R.)

52033 (CEA-CONF-1385) PHILLIPS SOURCE. Chamouard, P. A. ([Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires]). May 12, 1969. 18p. (In French). (CONF-690625-6). Dep. CFSTI (U. S. Sales Only).

From International Conference on Ion Sources, Saclay, France.

The discussion of the Phillips ion source covers the characteristics of the beam delivered by the source, description and assembling of the source, installation of the vacuum system, operation as a deuteron source, and testing of a point source. (J.F.P.)

52034 (CEA-R-3796) CONTRIBUTION TO THE STUDY OF THE MODULATION OF AN ELECTROSTATIC ACCELERATOR BEAM. Roche, Michel (Commissariat a l'Energie Atomique, Bruyeres-le-Chatel (France). Centre d'Etudes). July 1969. 143p. (In French). Dep. CFSTI (U. S. Sales Only).

After a presentation of some aspects of pulsation in an electrostatic accelerator, a more detailed description is given of a modulation of square wave form with the characteristic of having very short fronts (1.4×10^{-9} sec.); and regrouping by velocity modulation associated with the preceding device which has made it possible to obtain bursts of 0.45×10^{-9} sec. at half-height. (auth)

52035 (CEA-R-3842) TRANSIENT PHENOMENA DURING ELECTRON BEAM INJECTION IN THE SACLAY 45 MeV ACCELERATOR. Marcou, Jacques; Papiernik, Albert; Wartski, Louis (Paris Univ., Orsay (France). Institut d'Electronique Fondamentale); Bolore, Michel; Filippi, Gerard; Roland, Sixte (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). June 1969. 59p. (In French). Dep. CFSTI (U. S. Sales Only).

The principal features of transient phenomena, when electron beams are injected in a constant-field linear accelerator, are analyzed and interpreted by the use of a simple theory. The influence of these transient phenomena on the energy of accelerated particles is observed using a relatively precise method. For very large beam currents, nonlinear phenomena due to beam deformation can be exhibited, when the electron velocity is not exactly equal to the light velocity. (auth)

52036 (CEA-R-3846) NEW STRUCTURE FOR ACCELERATING HEAVY IONS. Pottier, Jacques (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). July 1969. 247p. (In French). Dep. CFSTI (U. S. Sales Only).

Thesis. Submitted to Univ. of Paris, Orsay, France.

A new type of accelerating structure is described which is particularly suited to heavy ions (high wave-length, high shunt impedance, small size). Its properties are analyzed and compared to those of other structures (more particularly the lines). It is shown that a mode of operation exists of which the shunt impedance in the station mode has 80 percent of its value for the progressive mode. Finally results are given obtained with a small experimental apparatus which uses this structure. (auth)

52037 (CEAL-1049) SEMI-ANNUAL REPORT FOR THE PERIOD JANUARY 1–JUNE 30, 1969. (Cambridge Electron Accelerator, Mass.). July 29, 1969. Contract AT(30-1)-2076. 47p. Dep. CFSTI.

The semiannual report is presented in six parts. Part one indicates the purpose of the contract, which is concerned with the operation of the 6-GeV Cambridge Electron Accelerator, and lists the main guiding committees. Part two, on accelerator operation, shows that the total number of delivered prime-user hours and parasite-user hours was 3630. The number of delivered prime-time hours was 2498 compared to 1546 in the previous six-month period; this is an increase of 62%. In March the highest-intensity (10 to 20 mA) long-term (8-day) 6-GeV run to date was achieved. Part three describes the 20 experiments underway or in preparation. Part four summarizes progress on the colliding beam facility (Project Bypass). For the first time a constant-energy electron beam was switched from the ring into the bypass, and in June a 1/e time constant of 25 seconds was achieved for such a beam. A better understanding of beam cross sections, ν values, chromaticity, momentum vector, and beta function is being attained, and it is apparent that longer time constants will soon be possible. The 130-MeV positron linac has been received, and by June 30, installation of parts was nearly complete. The injection runs, also, were nearly ready. The on-line detector is progressing well. Many of the principal components are being built, and most of the other equipment required is on order. Satisfactory progress was made on the optical detector and magnetic detector also. Part five summarizes the work done on various new projects. Part six deals with safety, and Part VII lists the major publications. (auth)

52038 (COO-1265-76) EXPERIENCE WITH THE WILLIAMS LABORATORY ON-LINE COMPUTER SYSTEM. Hobbie, Russell K.; Goodwin, Robert W. (Minnesota Univ., Minneapolis. John H. Williams Lab. of Nuclear Physics). [1969]. 12p. Dep. CFSTI.

A CDC 3100 was installed in 1965 and has been used for all experiments since the accelerator became operational. Fast data access is obtained by a direct route to memory which is not under program control. The advantages and disadvantages of such a system are discussed. A 2500-word operating system reserves data arrays, loads relocatable programs, processes real-time interrupts and provides typewriter control of program execution. For flexibility, all programs can be called either by other programs or by the control typewriter. Most user-written programs are in FORTRAN. FORTRAN programs can reference the data arrays reserved by the resident. A simple program storing system using the end of the library tape facilitates secondary computer use during long runs. Measurement of excitation functions has been almost completely automated with computer control of the accelerator energy. Improvements to the Digitek FORTRAN-II are described. (auth)

52039 (DESY-69/29) DISCONTINUOUS PHASE OSCILLATIONS IN PARTICLE ACCELERATORS. Bathow, G.; Freytag, E. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Aug. 1969. 30p. (In German). Dep. CFSTI (U. S. Sales Only).

Phase oscillations in particle accelerators are comprehensively treated for the case of discontinuous acceleration. A phase-oscillation parameter Z is introduced into the difference equation for the phase and energy deviations. This quantity Z covers the influence of the characteristic accelerator parameters on the phase motion;

it also describes the phase-amplitude damping. The results given show that, for accelerators having a constant Z of the order 1, resonances will occur which critically influence the phase stability. Analytic approximations are given for a qualitative survey of the numerical results. (auth)

52040 (FTI-AN-347) INVESTIGATIONS OF NONLINEAR SYNCHROTRON FLUCTUATIONS. Dovbnya, A. N.; Kononenko, S. G.; Reprintsev, L. V.; Shenderovich, A. M. (Akademiya Nauk Ukrainskoi SSR, Kharkov. Fiziko-Tekhnicheskii Institut). 1968. 5p. (In Russian). Dep. CFSTI (U. S. Sales Only).

Theoretical and experimental studies were made of resonances of nonlinear synchrotron oscillations and radiation damping in large-amplitude synchrotron oscillations. Effects of external fields and parametric resonances on the nonlinear synchrotron oscillations were studied using a 70 MeV electron storage ring. The results showed that the theoretical and experimental data are in good agreement. (R.V.J.)

52041 (IFVE-INZH-69-2) CALCULATED PARAMETERS OF THE SELF-FOCUSING LINAC MODEL. Mal'tsev, A. P.; Stepanov, V. B.; Teplyakov, V. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1969. 47p. (In Russian). Dep. CFSTI.

The parameters for the self-focusing proton linac model are calculated. The full energy of the model is 4.2 MeV, the pulsed beam current is 100 ml. The accelerating system is based on the H-cavity. The focusing is provided with double gap tubes with fingers. The calculation technique is described in detail and a total list of the formulas is given. The results of the calculations are represented in the form of the tables and diagrams. The model's construction is briefly described. (auth)

52042 (IFVE-INZH-69-3) A STUDY OF THE TRANSVERSAL OSCILLATIONS OF THE BEAM IN THE HARD-FOCUSING CHANNEL, USING A METHOD OF SWITCHING OFF THE LENSES. Kapchinskii, I. M.; Plotnikov, V. K.; Derienko, E. D. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1969. 14p. (In Russian). Dep. CFSTI (U. S. Sales Only).

A method of studying the transversal oscillations of the particles in the strong-focusing channel is worked out. The method is based on sequence switch off of the lenses and it was used for finding and localization of the channel errors. (auth)

52043 (ITEF-667) TO THE QUESTION OF THE QUASI-STOCHASTICAL INSTABILITY OF OSCILLATIONS OF PARTICLES IN RING-SHAPED ACCELERATORS AND ACCUMULATORS. Zenkevich, P. R. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1969. 15p. (In Russian). Dep. CFSTI (U. S. Sales Only).

In the process of the single resonance crossing, the amplitude of the particle oscillations may begin to increase stochastically due to the influence of the external noise factors. Such quasi-stochastical instability is investigated. (auth)

52044 (JINR-P9-4620) INVESTIGATION OF THE NEGATIVE MASS EFFECT ON THE ADGEZATOR MODEL. Ryltsev, P. I.; Sarantsev, V. P.; Fartushnyi, V. P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1969. 26p. (In Russian). Dep. CFSTI (U. S. Sales Only).

Instability of the negative mass type in dense electron beams in the adgezator model (adiabatic generator of charged toroids) has been investigated. The experimental results agree with recent theoretical predictions on the effect of screening on the oscillation increment in the perturbed beam. (auth)

52045 (JPRS-46949, pp 58-70) ACCELERATING FIELD OF A LINEAR INDUCTION ACCELERATOR. Vakhrushin, Yu. P.; Semenov, O. V. Translated from Zh. Tekh. Fiz., 38: 1521-8 (1968).

Equations are derived and solved for the accelerating field in a system of single-turn pulse transformers (inductors) arranged in tandem, in the cores of which the induction of the magnetic field varies linearly in time during the duration of the primary pulse in the transformer. Accelerators of this type have recently gained popularity for the production of relativistic electrons and powerful gamma quantum beams. Solutions of the differential equations yield the value of the accelerating electric field at different points of the system. The solution is obtained first for one inductor and is then extended by superposition for a system of inductors of limited length. The expressions derived can be solved only by numerical means. In addition, allowance is made for the boundary conditions brought about by the fact that the apparatus also contains other conducting metallic parts, as well as potential fields due to the space charge beam and the potential of the primary winding of the inductor. Where these fields do not affect the energy required by the individual particles in the accelerator, they do change the form of the accelerating field and must be taken into account. (ATD)

52046 (KFK-957) NORMAL AND SUPER CONDUCTIVITY HIGH-FREQUENCY ACCELERATOR AS POWER SOURCES FOR ELECTRON MICROSCOPES. Passow, C. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Experimentelle Kernphysik). Apr. 1969. 31p. (In German). Dep. CFSTI (U. S. Sales Only).

The use of linear accelerators as a high-voltage electron source for an electron microscope is discussed. Some qualities of different normal and superconducting accelerators are considered with respect to this application. It seems that, because of its high duty cycle, a superconductor accelerator is a feasible source Some problems of cryotechnics and voltage control as well as some problems of particle dynamics have to be solved to get a maximum duty cycle gas. (auth)

52047 (LIB/Trans-215) FOCUSING CHARACTERISTICS OF ELECTRIC FIELDS. Higatsberger, Michael J. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf). Translated by J. B. Hopkinson (Australian Atomic Energy Commission Research Establishment, Lucas Heights), from report SGAE-G-3/1965. 10p. Dep. CFSTI (U. S. Sales Only).

An abstract of this paper, prepared from the original language, appeared as NSA 20: 9613. (B.G.D.)

52048 (ORNL-TM-2686) SURVEY OF METHODS OF ACCELERATING HEAVY IONS. Livingston, Robert S. (Oak Ridge National Lab., Tenn.). Oct. 1969. Contract W-7405-eng-26. 45p. (CONF-690921-1). Dep. CFSTI.

From International Cyclotron Conference, Oxford, England.

The many and varied methods for accelerating heavy ions to energies useful for nuclear physics and nuclear chemistry are reviewed. The traditional methods using cyclotrons and linear accelerators are being upgraded in a variety of ways. Schemes incorporating new accelerator physics, the collective effects systems, and charge changing systems are under development and may emerge soon as important new methods. Superconducting linacs are rapidly coming into their own and may be serious contenders as heavy ion accelerators in the near future. (auth)

52049 (ORNL-tr-3027) SHIELDING PROBLEMS CONNECTED WITH THE INTENSITY INCREASE OF THE FRASCATI ELECTRO-SYNCHROTRON. Pelliccioni, M.; Picchi, P.; Verri, G. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). Trannslated for Oak Ridge National Lab., Tenn., from report LNF-68/55. 10p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 23: 3863. (W.H.K.)

52050 (PPAD-666-D) HEAVY ION IMPROVEMENT PROGRAM. (Princeton-Pennsylvania Accelerator, Princeton, N. J.). Sept. 30, 1969. Contract AT(30-1)-2137. 34p. Dep. CFSTI.

A proposal is presented for a Heavy Ion Improvement Program for the Princeton-Pennsylvania Accelerator (PPA). The proposal is divided into four main phases. The emphasis of the first two phases is on searching for the super heavy transuranic elements and on those nuclear structure problems which can be studied with very heavy projectiles with energies in the region of 5–50 MeV per nucleon. Even in these first two phases, light to medium heavy nuclei can be accelerated to much higher energies, up to 1200 MeV per nucleon. The last two phases of this program make available the heaviest ions at the maximum PPA energy, e.g., uranium at 800 MeV per nucleon, which would exceed by far any other heavy ion accelerator thus far proposed. (B.G.D.)

52051 (SLAC-110) TWO-MILE ACCELERATOR PROJECT. Quarterly Status Report, April 1–June 30, 1969. (Stanford Linear Accelerator Center, Calif.). Sept. 1969. Contracts AT(04-3)-400; AT(04-3)-515. 60p. Dep. CFSTI.

A status report on the Stanford Linear Accelerator Project covering the period April 1, 1969 to June 30, 1969 is presented. Topics included are accelerator and research area operations, accelerator and research area equipment development, and physics research equipment development. (auth)

52052 (TRI-67-2) MAGNETIC FIELD TOLERANCES FOR A SIX-SECTOR 500 MeV H^- CYCLOTRON. Craddock, M. K.; Richardson, J. Reginald (TRI - Univ. Meson Facility, Vancouver (British Columbia)). Dec. 1968. 43p. Dep. CFSTI (U. S. Sales Only).

The tolerances which beam dynamical requirements place on the accuracy to which the cyclotron magnet must be constructed and its magnetic field measured are discussed. The tolerance most significantly affecting manufacturing methods is probably that de-

manded of the spiral shape of the sectors to keep vertical focusing within acceptable limits. At large radii the precision required reaches ±0.033°C and will necessitate a shimming programme subsequent to manufacture. The associated ±7 G tolerance on the field flutter should be easier to achieve. Isochronism sufficient to give 36% microscopic duty factor can be provided by a radial field gradient correct to ±2 G/ft together with 35 circular trim coils. Separated turn acceleration would require ±1 G/ft with 54 trim coils and very closely controlled dee voltage, radio frequency and magnet excitation. To avoid the poor energy resolution resulting from large radial betatron oscillations, the first harmonic field amplitude must not exceed 0.2 G; this demands 72 harmonic trim coils, ±0.14° accuracy in placing the sectors, and uniformity in their reluctance to 0.5%. Finally, to keep electric stripping of the H^- ions within ±10% limits, the hill magnetic field must meet ±0.4% limits over the outer 20 in. (auth)

52053 (TRI-68-2) BUILDING CONCEPT WITH COST ESTIMATES, SITE EXPLORATION AND ENGINEERING DATA FOR A 500 MeV H^- CYCLOTRON FACILITY. Oakey, J. R. (TRI - Univ. Meson Facility, Vancouver (British Columbia)). July 1968. 71p. Dep. CFSTI (U. S. Sales Only).

The conceptual building design and site layout for TRIUMF, considering the immediate requirement of constructing a workshop, laboratory and office building on the TRIUMF site as well as future expansion of the facility are described. Services, such as electrical, mechanical, cooling, etc., required for the cyclotron and ancillary equipment are described in some detail, as well as facilities for handling the heavy cyclotron components and radiation shielding blocks, and cost optimization studies were made. A survey of the various materials suitable for radiation shielding considering local availability and cost is included, and overall cost estimates for buildings and radiation shielding are provided. (auth)

52054 (TRI-69-6) ENERGY RESOLUTION IN A 500 MeV H^- CYCLOTRON. Richardson, J. Reginald (TRI - Univ. Meson Facility, Vancouver (British Columbia)). June 1969. 22p. Dep. CFSTI (U. S. Sales Only).

The energy resolution to be expected from a 500 MeV H^- cyclotron is described for the following four cases: energy resolution of the raw beam, with no selection process in the cyclotron, energy resolution with low energy defining slits to limit the amplitude of radial oscillations, separated turn acceleration and extraction, and selection of energy by determining three points on the final orbits. (B.G.D.)

52055 (UCRL-18892) ELECTROSTATIC AND MAGNETOSTATIC IMAGE-FIELD COEFFICIENTS. Laslett, L. Jackson (California Univ., Berkeley. Lawrence Radiation Lab.). June 1969. 17p. (CONF-690811-10). Dep. CFSTI.

From 7th International Conference on High Energy Accelerators, Moscow, USSR.

The derivation of image-field coefficients is sketched and results are presented for a particle beam centrally located within closed (elliptical or rectangular) picture-frame boundaries. Image-field coefficients are also given for structures that might usefully be added to a synchrotron to modify the frequencies of incoherent betatron oscillations. (auth)

52056 (UCRL-18916) TABLES AND GRAPHS OF FIRST ORDER PERTURBATION EFFECTS IN IRON DOMINATED TWO DIMENSIONAL SYMMETRICAL MULTIPOLES. Halbach, Klaus; Yourd, Ron (California Univ., Berkeley. Lawrence Radiation Lab.). May 1969. Contract W-7405-eng-48. 30p. Dep. CFSTI.

The following quantities were tabulated for N = 2, 3, 4: j_n, b_n, a_n, p_n, $b_n \pm a_n$, G_x, G_y, $P_n/\mathrm{Cos}(\pi/2 \cdot n/N)$, as well as these quantities multiplied by n/N. For N = 6, 8, 12 the following basic quantities were tabulated: j_n, n/N, $b_n \cdot n/N$, $a_n \cdot n/N$, $p_n \cdot n/N$. (M.C.G.)

52057 INFLUENCE OF BEAM STRUCTURE ON THE STABILITY OF ULTRARELATIVISTIC PARTICLES IN A DIAPHRAGM WAVEGUIDE. Polukhin, A. T. Vestn. Mosk. Univ., Ser. III, Fiz. Astron., No. 4, 112-14(July-Aug. 1969). (In Russian).

Linear accelerator threshold instabilities, instabilities of mono-energetic particle beams, and axial currents were analyzed previously. An attempt is made to determine the instabilities as a function of the particle dispersion by pulses and as a function of particle density distribution. It is shown that for a wide class of density distribution in a beam, such instabilities are absent. Formulas are obtained for the threshold current instabilities. (R.V.J.)

52058 NEUTRON-GENERATING TARGETS. (to Commissariat a l'Energie Atomique). British Patent 1,164,780. Sept. 24, 1969. Priority date Sept. 15, 1967, France.

Fabrication of a target for neutron production by (d,n) reactions with tritium or deuterium is described. The target comprises a mixture of hydrides of two or more metals so that one is hydrogenated to the hydride with an accompanying increase in volume and another is hydrogenated to the hydride with an accompanying decrease in volume. (W.H.K.)

52059 COMMENTS ON THE ACCELERATION OF ENERGETIC ELECTRONS. Kerst, Donald W. (Univ. of Wisconsin, Madison). Ann. N. Y. Acad. Sci., 161: 30-2(July 3, 1969).

From Conference on High Energy Radiation Therapy Dosimetry, New York. See CONF-670665.

A historical review is presented on the development of electron accelerators. (B.G.D.)

52060 SPACE CHARGE FIELD OF ELECTRON AXIAL SYMMETRICAL BUNCHES. Movsisyan, L. M. At. Energ. (USSR), 27: 69-71(July 1969). (In Russian).

The fields for cylindrical or ellipsoidal shaped electron bunches with a uniform and linear charge distribution along the bunches were studied previously. Formulas are developed for determining bunches with more complex shapes and with linear and quadratic distribution of the charge density along the bunch. Tabulated data are given for the space-charge field of ellipsoid, cylinder, rounded cylinder, conic, and drop-shaped bunches with a uniform charge distribution. (R.V.J.)

52061 METER FOR MEASURING THE TRANSVERSE COMPONENT OF THE MAGNETIC FIELD IN A LINEAR ACCELERATOR. Kizilov, V. U.; Skubko, V. A. Izmer. Tekh., No. 5, 67-8 (May 1969). (In Russian).

The main characteristics and a circuit diagram are presented for a magnetometer with a Permalloy-core transformer for measuring the transverse component of the magnetic field in a shielded volume. (tr-auth)

52062 SECOND APPROXIMATION CALCULATIONS OF SYNCHROTRON RADIATION. Shishanin, O. E. Vestn. Mosk. Univ., Ser. III. Fiz. Astron., No. 4, 103-5(July-Aug. 1969). (In Russian).

Precision formulas are presented for synchrotron radiation for spiral and circular electron motion in a homogeneous magnetic field. (R.V.J.)

52063 INFLUENCE OF RADIATION DAMPING DURING ELECTRON MOTION IN A SPIRAL ORBIT. Gere, G. Vestn. Mosk. Univ., Ser. III. Fiz. Astron., No. 4, 60-4(July-Aug. 1969). (In Russian).

Electron motion along the spiral in a constant homogeneous field directed along the axis z was studied. Results are given of calculations according to classical approximations without considering quantum corrections and calculations according to the quantum theory with quantum corrections for intensities and quantum fluctuations. The total energy E, transverse energy $E_\perp$, and the component z of the wave vector k_3 as functions of time were calculated. (tr-auth)

52064 EXPERIMENTAL DETERMINATION OF RELATION OF ACCELERATION CURRENT TO PRESSURE IN THE CHAMBER OF THE SIRIUS SYNCHROTRON. Chuchalin, I. P.; Dvoretskii, M. I. Izv. Vyssh. Ucheb. Zaved., Fiz., No. 2, 31-5(1969). (In Russian).

Results are given of experimental investigations of the relation of accelerated charges in a synchrotron to pressure in the vacuum chamber. In the region of pressures from 5×10^{-6} to 2×10^{-5} torr, experimental and estimated results coincided. (tr-auth)

52065 PROCEEDINGS OF THE CONFERENCE ON RADIATION PROTECTION IN ACCELERATOR ENVIRONMENTS, CHILTON, ENGLAND, MARCH 1969. Stevenson, G. R. (ed.). Chilton, Eng., Rutherford Laboratory, 1969. 171p. 40s. (CONF-690320).

Separate abstracts were prepared for the 20 papers presented. (W.H.K.)

For abstracts of individual papers see: 50138-50143, 50177, 50178, 50182, and 52066-52076.

52066 ACCELERATORS, PHYSICS, AND HEALTH. Perry, D. R.; Hargreaves, D. M. (Rutherford Lab., Chilton, Eng.). pp 3-7 of Proceedings of the Conference on Radiation Protection in Accelerator Environments, Chilton, England, March 1969. Stevenson, G. R. (ed.). Chilton, Eng., Rutherford Laboratory, 1969.

See CONF-690320.

Radiological safety aspects of accelerators of different kinds and energies are examined and compared. The production and properties of stray radiation and induced radioactivity are discussed, particularly in relation to problems of shielding design, dosimetry, accelerator maintenance, and radioactive contamination. Consideration is given to the relative significance of different hazards in various situations. (auth) (UK)

52067 RADIOACTIVITY INDUCED BY HIGH ENERGY ELECTRONS. Saxon, G. (Daresbury Nuclear Physics Lab., Eng.). pp 8-12 of Proceedings of the Conference on Radiation Protection in Accelerator Environments, Chilton, England, March 1969. Stevenson, G. R. (ed.). Chilton, Eng., Rutherford Laboratory, 1969.

See CONF-690320.

The electron synchrotron, NINA, at Daresbury has an average beam current of about 1 μA at an energy up to 5 GeV. It runs on a 20 days on/8 days off duty cycle. An attempt was made to assess the long-term activities which can be built up by such a beam in various materials, and the distribution of the activation with depth in these materials. (auth) (UK)

52068 CALCULATION OF THE MAXIMUM PERMISSIBLE CONCENTRATION OF ^{15}O IN THE AIR. Jones, T.; Turner, B. A.; Fowler, J. F. (Hammersmith Hospital, London). pp 13-18 of Proceedings of the Conference on Radiation Protection in Accelerator Environments, Chilton, England, March 1969. Stevenson, G. R. (ed.). Chilton, Eng., Rutherford Laboratory, 1969.

See CONF-690320.

Oxygen-15 is produced in the environment of certain positive ion accelerators, thus constituting a potential hazard. The general approach to the calculation of the maximum permissible concentration of this isotope in air is presented. (auth) (UK)

52069 EXTERNAL RADIATION FIELD FROM PROTON SYNCHROTRONS. Stevenson, G. R.; Shaw, K. B. (Rutherford Lab., Chilton, Eng.). pp 19-25 of Proceedings of the Conference on Radiation Protection in Accelerator Environments, Chilton, England, March 1969. Stevenson, G. R. (ed.). Chilton, Eng., Rutherford Laboratory, 1969.

See CONF-690320.

The production of stray radiation fields is discussed in terms of the nucleon induced cascade. The spectrum of the radiation emerging from a thick shield, and the production of radionuclides which can give rise to significant dose rates under machine-off conditions are described. (auth) (UK)

52070 THE RADIATION FIELD OF THE OXFORD COUPLED ELECTROSTATIC GENERATORS. Hyder, H. R. McK. (Oxford Univ.). pp 26-33 of Proceedings of the Conference on Radiation Protection in Accelerator Environments, Chilton, England, March 1969. Stevenson, G. R. (ed.). Chilton, Eng., Rutherford Laboratory, 1969.

See CONF-690320.

The Oxford Coupled Electrostatic Generators consist of a reversible polarity vertical Van de Graaff and a horizontal tandem Van de Graaff. The accelerators can be operated independently, to produce beams of light ions of about 12 MeV and of heavy ions of up to 40 MeV, or coupled to produce beams of protons and deuterons of about 20 MeV and heavy ions of up to 70 MeV. The radiation field produced by the accelerators working separately and coupled was measured for a range of ions and energies. The measurements show that with the designs of accelerating tubes required to ensure satisfactory operation at high energies, X-radiation from the accelerators is of low energy and intensity and does not constitute a serious radiation hazard. The measured intensity of fast neutrons produced by the accelerated ion beams is in reasonable agreement with published thick target neutron yields. The extent and intensity of the measured fast neutron dose rates have enabled the principal sources of radiation to be identified and have shown that the system of restricted access and permanent shielding is adequate for the range of operations which the accelerators perform. (auth) (UK)

52071 LAY-OUT AND SHIELDING FOR 3 HOSPITAL ACCELERATORS. Stephenson, S. Kenneth (Christie Hospital and Holt Radium Inst., Manchester, Eng.). pp 36-9 of Proceedings of the Conference on Radiation Protection in Accelerator Environments, Chilton, England, March 1969. Stevenson, G. R. (ed.). Chilton, Eng., Rutherford Laboratory, 1969.

See CONF-690320.

The shielding designed for 3 accelerator installations at this hospital is discussed. The accelerators concerned are a 4 MV, Series 2, A.E.I. Medical Orthotron, a 8 MV, Mullard, SL, 75 Medical Accelerator, and a 12,5 MeV, Vickers Research Electron Accelerator. (auth) (UK)

52072 DESIGN CONSIDERATIONS FOR DEALING WITH ACCELERATOR PRODUCED RADIATION. Awschalom, Miguel (National Accelerator Lab., Batavia, Ill.). pp 41-52 of Proceedings of the Conference on Radiation Protection in Accelerator Environments, Chilton, England, March 1969. Stevenson, G. R. (ed.). Chilton, Eng., Rutherford Laboratory, 1969.

See CONF-690320.

Particle losses must be minimized to avoid adverse effects such as radioactivation of the accelerator proper, its enclosure, cooling water and air, and their induced remanent exposure rates; changes in the material properties of the accelerator components; creation of neutrons and pions, which require biological shields to protect people from the neutrons and the muons from the pion decays; and decrease in the useful output beam. Losses along a linac may be minimized by proper design of the low energy section ("prebunching"). Clean linacs are weak sources of x-rays. Losses along synchrotrons may be localized by the judicious use of beam scrapers. These scrapers may also be required to act as emergency beam dumps. Hence they, as well as some of the downstream magnets, must be properly shielded. Internal targets should be banned. The accelerators must be designed for clean injection and extraction. The external beam target stations must be designed in such a manner that targets, collimators, magnets, etc., may be taken to "hot cells" for maintenance and disposal. Once beam losses are localized and the absolute intensity is limited, it may be found that only a rather thin earth shield is needed over the accelerator and external proton beams. (auth) (UK)

52073 ELECTRON ACCELERATORS. Innes, G. S. (St. Bartholomew's Hospital, London). pp 114-20 of Proceedings of the Conference on Radiation Protection in Accelerator Environments, Chilton, England, March 1969. Stevenson, G. R. (ed.). Chilton, Eng., Rutherford Laboratory, 1969.

See CONF-690320.

In hospitals, where high voltage electron accelerators are used for clinical treatment, not only have hazards to operational staff to be guarded against, but also those to which the patients may be subjected. This is particularly so when the same machine is used to provide both x-ray and electron beam facilities. When such a machine is used for all types of physical investigations, flexible operational conditions are necessary. These two modes of use, clinical and physical investigations, with their conflicting requirements, introduce the need for exceptionally safe security circuits and controls over and above those required for clinical machines. These are discussed, together with environmental hazards introduced by the multi-lateral use of the machine. (auth) (UK)

52074 HEALTH PHYSICS OPERATIONS AT THE HARWELL VARIABLE ENERGY CYCLOTRON. Pond, S. F. (Atomic Energy Research Establishment, Harwell, Eng.). pp 136-42 of Proceedings of the Conference on Radiation Protection in Accelerator Environments, Chilton, England, March 1969. Stevenson, G. R. (ed.). Chilton, Eng., Rutherford Laboratory, 1969.

See CONF-690320.

The Harwell Variable Energy Cyclotron has been in operation for just over three years. The first year was spent in commissioning and since then over 55 beams consisting of light and heavy ions of various energies have been extracted. Some of the operational health physics problems encountered in this time are described, both during machine running and shutdown periods, together with some of the special problems posed by the experimenters using the cyclotron. (auth) (UK)

52075 CYCLOTRON FOR MEDICAL USE. Jones, T. (Hammersmith Hospital, London). pp 143-52 of Proceedings of the Conference on Radiation Protection in Accelerator Environments, Chilton, England, March 1969. Stevenson, G. R. (ed.). Chilton, Eng., Rutherford Laboratory, 1969.

See CONF-690320.

Health Physics experiences with the Medical Research Council's Cyclotron are described, with particular reference to the hazards associated with the production and processing of radioisotopes, neutron beam use and cyclotron maintenance. (auth) (UK)

52076 PRACTICAL HEALTH PHYSICS AROUND NIMROD. Hack, R. C. (Rutherford Lab., Chilton, Eng.). pp 153-63 of Proceedings of the Conference on Radiation Protection in Accelerator Environments, Chilton, England, March 1969. Stevenson, G. R. (ed.). Chilton, Eng., Rutherford Laboratory, 1969.

See CONF-690320.

The current health physics problems associated with the operation of Nimrod are briefly described, together with a description of measurement techniques and operational procedures. (auth) (UK)

52077 CHARGED PARTICLE ACCELERATORS. Abromyan, Eugeni Aramovich; Vasseman, Sekko Borisovich; Gapanov, Vasily Alexandrovich; Krainov, Gennody Sergevich (to Insistut Yadernoi Fisiki Sibirskogo Ocdelenis Akademii Nauk). British Patent 1,163,522. Sept. 10, 1969. Filed Aug. 25, 1966.

Reference is made to apparatus for accelerating charged particles to energies up to several MeV in which use is made of an impulse-excited resonance transformer or Tesla coil. Present accelerators of this type suffer from considerable energy losses

by Joule heating in the transformer, and have the disadvantages of a significant time-dependent scatter of the energy of the charged particles, and the impossibility of producing high pulse currents of charged particles, since much of the energy stored in the primary circuit is carried away with the beam; the Tesla coil also has a low efficiency. The system described provides a simple and compact accelerator having high efficiency and operational reliability, and may be used to produce particle currents up to several hundred Amperes at an energy of a few MeV, with a pulse duration in the range 10^{-9} to 10^{-5} sec. The system gives an increased coupling coefficient between the windings of the transformer, an increased distributed capacity of the secondary ionizing, and means for current control. The system consists of a Tesla coil and housing, an electrode for achieving uniform distribution of high potential between the secondary winding and the housing, and accelerating means inside the secondary winding open conducting screen is disposed between the primary and secondary windings of the coil, and a control grid is mounted close to an injector or gun. The electrode for achieving uniform distribution of high potential is permeable to variable magnetic flux. The electrode may be in the form of a dielectric framework upon which is provided a winding having separate turns connected to an equalizing ring. (UK)

52078 EFFICIENT SELECTION FROM PLASMA OF HIGH-DENSITY ELECTRON CURRENTS INTO A VACUUM. Gutova, L. A.; Kreindel, Yu. E.; Nikitinskii, V. A. (Tomsk Inst. of Radioelectronics and Electron Techniques, USSR). Izv. Vyssh. Ucheb. Zaved., Fiz., No. 12, 130-3(1968). (In Russian).

Effective extraction of electron beam (with tens and hundreds milliamper current) into a vacuum from a Penning discharge plasma through an anode opening was studied. Data obtained showed that there are two methods of electron current selection which differ considerably in their efficiency at identical extraction voltages. An efficient current selection brings into the vacuum an electron current up to 20 A at current density of about 200 A/cm^2. The transition was obtained by varying parameters of the Penning discharge. (R.V.J.)

52079 THEORETICAL STUDY OF THE RADIATION FROM AN ELECTRON BUNCH CIRCULATING ABOUT THE AXIS OF AN ACCELERATOR TUBE WITH AN IRIS. Marcou, Jacques; Papiernik, Albert; Wartski, Louis (CNRS, Orsay, France). Compt. Rend., Ser. B, 268: 1557-60(June 16, 1969). (In French).

The electromagnetic field of an accelerator tube is profoundly disturbed by radiation due to an electron beam divided into bunches. To determine exactly the importance of these transient phenomena, the field radiated by a unique bunch is calculated, taking into account the real dispersion curve of the tube. (tr-auth)

52080 DEVICE FOR DRAWING OUT AN ELECTRON BEAM IN SUCH PARTICLE ACCELERATORS AS THE BETATRON. Suzuki, Tooru (to Tokyo Shibaura Elec. Co.) Japanese Patent 1969-7240. Mar. 29, 1969. Filed Aug. 24, 1965.

The device is used for drawing out a beam of high-energy electrons from a betatron. In betatrons for medical use, the narrow beam of electrons from the accelerator is widened to provide a broad irradiation field. By the proposed method, the distribution of dosage in this irradiation field can be uniform, thereby leading to the uniform exposure of a lesion for increasing the therapeutic effect. Furthermore, the area of irradiation field can be changed easily. The device proposed consists of the following: an electromagnetic device installed in the path of an electron beam from the accelerator for deflecting alternately the electron beam; and a means, installed at the electromagnetic device, for suspending the deflecting magnetic field periodically. (NSA of Japan)

52081 CIRCULAR TRIMMING COILS MOUNTED ON MAGNET POLE FACES. Nakanishi, Noriyoshi; Motonaga, Shoshichi; Miyazawa, Yoshitoshi; Karasawa, Takashi (Inst. of Physical and Chemical Research, Saitama, Japan). Jap. J. Appl. Phys., 8: 1229-36(Oct. 1969).

Effects of circular pole face coils which are mounted on both surfaces of the magnet pole tips have been investigated. Agreement between the results of experiment and numerical calculation was satisfactory over wide range of change of the magnetic field caused by the changing permeability of iron. The magnet pole pieces employed in preliminary and main experiments have profiles of hyperbolic-cosine type and edgeless type, respectively. The pole face coils are useful for correction of the radial distribution of the magnetic field. Such coils are used for the 160-cm ordinary type variable energy cyclotron which has been newly constructed in the Institute of Physical and Chemical Research. (auth)

52082 OPTIMIZING THE DEFLECTOR CONTROL CIRCUIT OF THE ROSSENDORF CYCLOTRON. Borkenhagen, M.; Ernst, D. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie, 12: 271-4(Aug. 1969). (In German).

An ALGOL program for the computation of Nyquist plot of a special control circuit is described. The optimum adjustment of the control circuit is determined graphically. (auth)

52083 RADIATION PLUG FOR A PARTICLE ACCELERATOR BEAM TUBE. Parker, G. W. (to U. S. Atomic Energy Commission). U. S. Patent 3,473,029. Oct 14, 1969.

A water-filled shielding plug for use in a particle accelerator beam tube and adapted to be inserted into the beam tube from a branch tube is described which includes a metallic bellows closed at both ends and a wire for limiting longitudinal expansion of the bellows. (AEC)

52084 INVESTIGATION OF THE IMAGE PARAMETERS IN MAGNETIC FOCUSING PRISMS WITH r^{-1} FIELDS. Fedoseev, E. P. Zh. Tekh. Fiz., 38: 1330-5(Aug. 1968). (In Russian).

This is a continuation of earlier work and is devoted to a determination of the optimal conditions of focusing of paraxial beams in a magnetic prism with an R^{-1} field. An analysis of the expressions obtained in an earlier paper for the beam image parameters produced by such a prism has shown that the magnification of this system is directly proportional to the exit focal distance and inversely proportional to the entrance focal distance, and has a negative sign. Such a dependence of the magnification of the system shows that the relative dispersion of the system remains unchanged when the exit arm is varied. It is also shown that when the angles between the radii passing through the points of intersection of the principal central trajectory and the edges of the prisms are equal to 180°, the image always remains in the form of a straight line. The aberration then becomes minimal, and equals the magnified dimension of the source in the central plane. This realizes second-order focusing in the radial plane and the resolution of the instrument is then maximal. Double focusing of the indicated systems can be realized only in first order. The field of such a system can be used both in apparatus for the analysis of charged particles and in mass separators of commercial type. (ATD)

52085 FOCUSING PROPERTIES OF A TOROIDAL ELECTROSTATICAL FIELD. Zashkvara, V. V.; Korsunskii, M. I.; Red'kin, V. S. Zh. Tekh. Fiz., 38: 1336-43(Aug. 1968). (In Russian).

The authors consider, in first approximation, the focusing of a beam of charged particles in an axially-symmetrical electrostatic field, which is produced in a space between two oppositely charged electrodes that are close in configuration to circular toruses. An electron-optical setup is considered, with toroidal sector field, which makes it possible to gather a beam of charged particles emerging from a long angular slit of the source into a circle of small size located on the symmetry axis of the system. The form of the electrodes of the focusing toroidal system differs little from the form of circular toruses. A toroidal electrostatic field, having single equipotential surface and a circular-torus configuration is determined in a spherical coordinate system. The field intensity on this surface is constant. The parameters of the expansion of the potential of the field in the vicinity of the equipotential surface are determined. The motion of the ions is investigated in first approximation in the vicinity of the equipotential surface, and the region of the angles for which the toroidal field is radially focusing, with a variable focusing coefficient, is determined. (ATD)

52086 MAGNETIC FOCUSING PRISMS WITH r^{-1} FIELDS FOR FOCUSING OF THE CHARGED PARTICLES BEAMS WITH HIGH ANGULAR-WIDTH. Fedoseev, E. P. Zh. Tekh. Fiz., 38: 1320-9(Aug. 1968). (In Russian).

This is a continuation of earlier work and is devoted to a derivation and solution of the equations of the spatial trajectories of charged particles as a function of the geometrical and chromatic characteristics of the beam in a magnetic lens with r^{-1} field, in which the focal distances are arbitrary and do not depend on the focusing angle. Geometrical calculations have shown that in order to realize ideal focusing in the center plane of such a lens it is necessary that its edges have the form of circles whose diameters are bounded by the focus and by the center of the system. Fundamental relations are presented, characterizing the focusing properties of the ion-optical system as a whole, and the values of the image parameters in the focal plane are determined. It is shown that the particle path from the source to the receiver will be minimal if the ratio of the focal distance to the radius of the central circle of the lens is equal to the angle contained between the radii passing through the points that intersect the principal

central trajectory with the edges of the lens. The results of the calculations demonstrate the feasibility of employing input beams with a total divergence angle 25 to 35° and more, thus making the use of such lenses highly promising for mass separators of high productivity, particularly if the purpose is to accumulate low-abundance isotopes. (ATD)

52087 ORSAY LINEAR ACCELERATOR. I. GENERAL DESCRIPTION AND THE ACTUAL SITUATION. Blanc-Lapierre, A. (Ecole Normale Superieure, Orsay, France). Onde Elect., 49: 723-6(July-Aug. 1969). (In French).

The Orsay electron linear accelerator has increased its performances in energy and current. Associated with the electron and positron colliding beam, it offers interesting possibilities for high energy physics. (auth)

52088 ORSAY LINEAR ACCELERATOR. II. LINEAR ACCELERATOR AND ITS RECENT EXTENSION. Brunet, P.; Buffet, X.; Burnod, L.; Dardenne, G.; Liot, R. (Ecole Normale Superieure, Orsay, France). Onde Elect., 49: 727-66(July-Aug. 1969). (In French).

Design modifications for increasing the energy of the Orsay electron linear accelerator to 2.3 GeV are described. (auth)

52089 ORSAY LINEAR ACCELERATOR. III. EXPERIMENTS WITH THE ORSAY LINEAR ACCELERATOR. Grossetete B. (Ecole Normale Superieure, Orsay, France). Onde Elect., 49: 767-77(July-Aug. 1969). (In French).

Experiments realized with the Orsay Linac are described, particularly those concerning scattering of electrons (or positrons) on atomic nuclei and protons, and photoproduction of π mesons on protons. A short description of the apparatus connected with the experiments is given. An outlook on the new possibilities offered by the construction of the extension is likewise discussed (possibility of studying numerous mesonic and baryonic resonances). (auth)

52090 ORSAY LINEAR ACCELERATOR. IV. NEW RING FOR MULTI-GeV ELECTRON–POSITRON COLLISIONS USING THE ORSAY LINEAR ACCELERATOR AS THE INJECTOR. Marin, P. (CNRS, Orsay, France). Onde Elect., 49: 778-83 (July-Aug. 1969). (In French).

After a short survey on the Orsay strong focusing electron-positron colliding beams, the idea of a ring with space-charge compensation is briefly outlined as well as the advantages which result. The use of the Orsay Linear Accelerator together with its new extension as an injector for a multigev ring is described. (auth)

52091 ORSAY LINEAR ACCELERATOR. V. PROBLEMS ENCOUNTERED IN STUDY AND REALIZATION OF MODULATORS AND SECTIONS. Azam, G.; Bonvalot, R.; Milcamps, J.; Tronc, D. (Thomson-CSF, Corbeville, France). Onde Elect., 49: 784-90(July-Aug. 1969). (In French).

Problems encountered and resolved by the constructor THOMSON-CSF are discussed. Critical points of modulator design, and HF methods and measurements aimed at coupling between the structure and the electromagnetic source without perturbation of the beam, and, control and adjustment of the accelerating field and its perfect synchronism with the beam are described. (auth)

52092 THE NEW LINEAR ACCELERATOR AT SACLAY. Malleroy, Antoine. Atomes (Paris), 24: 378-80(June 1969). (In French).

Characteristics of the Saclay linear accelerator are reported as follows: frequency, 3000 MHz; 30 accelerator sections, each 6 m long fed by 15 60-KW (unitary) klystrons; duration of impulse, 10 μsec; functioning in use cycle, 1 or 2%; performance for electron beams, (data for 1 or 2% functioning, respectively) frequency of repetition, 1 KHz, 2 KHz; mean klystron power, 40 KW, 40 KW; E_{max}, vacuum, 640 MeV, 450 MeV; E_{max} and I_{mean} for 100-KW beam, 590 MeV, 170 μa, 420 MeV, 240 μa; maximum intensity E_{max}, I_{mean}, and P_{mean}, 420 MeV, 800 μa, 330 KW, 300 MeV, 1120 μa, 330 KW. Energy dispersion of nonanalyzed beam, 10^{-2}; performance for positron beams at 1% cycle, F_{max} 550 MeV; at 2% cycle, 390 MeV. Experiments planned with the accelerator include electron diffusion experiments with and without particle production, which will require two experimentation chambers, one for very high performance and the other for lower but more simple utilization. Further studies will be devoted to pion and muon experiments. (BBB)

52093 COMPUTATION OF LIMITS ON THE EFFICIENCY OF ION SOURCES UTILIZING IONIZATION BY ELECTRON IMPACT. Slobodenyuk, G. I. Zh. Tekh. Fiz., 38: 1182-8(July 1968). (In Russian).

A review of theoretical limits on the performance of such sources is given to facilitate the design of ion sources. The basic limit on the ion current is the partial pressure of the gas which forms the source of ions. The efficiency of production depends on the degree of ionization and on factors that lead to competing processes. A second important factor is the electron beam that ionizes the neutral gas. The current density for such beams is computed and takes into account the ionization cross section, beam spreading, and the extent of the active region. The maximum current density is limited by a space charge and corresponding expressions for axially symmetric and sheet beams are given. Finally, the conditions for the optimum operating regime of the ion sources are derived for the conditions of full ionization in the active region. These in turn lead to expressions for ion currents derived on the assumption that ion flow is laminar. An added feature of this analysis is that it is also applicable to estimating the pumping speed limits in the gas-discharge pumps. (ATD)

52094 THE USE OF GAUSS BRACKETS FOR THE DESIGN OF MANY-ELEMENT ELECTRON-OPTICAL SYSTEMS. Dymnikov, A. D. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekh. Fiz., 38: 1120-5(July 1968). (In Russian).

The possibility of using Gauss brackets, which are customarily used in ordinary optics, for the design of multielement electron-optical systems is demonstrated. The matrix of the lens is represented in the form of a product of three matrices, characterizing a thick optical lens, whose elements represent the distance from the principal plane of image space to the rear and front boundaries of the field of the lens or the system of lenses, and also the focal distance. Expressions are presented for the matrix elements of an orthogonal system and formulas are presented for the focal distances and positions of the foci of a system consisting of many lenses. Gauss brackets are used also to obtain expressions for electron-optical characteristics of a system of quadrupole lenses. It is noted that the Gauss brackets make it possible to write down the characteristics of multielement optical systems in a very compact form and by the same token facilitate the investigation of the properties of such systems. (ATD)

52095 100 kV ACCELERATOR FOR STUDYING THE REACTION $^3H(t,\alpha)2n$. Larose-Poutissou, R.; Jeremie, H. (Univ. de Montreal). Nucl. Instrum. Methods, 174: 179-80(1969). (In French).

A brief description is given of a 100 kV single-gap accelerator for the study of the coincidence-spectra of the $^3H(t,\alpha)2n$ reaction. (auth)

52096 UNDULATORY SYNCHROTRON. Fomenko, G. P.; Yuskov, Yu. G. Zh. Tekh. Fiz., 39: 1658-63(Sept. 1969). (In Russian).

Intense electron beams satisfying rigid specifications as to geometrical parameters and allowable energy spread can be obtained by injecting electrons into a resonator at the maximum of a standing wave which is excited in the resonator. The electrons receive an energy eV cos θ, and then enter a magnetic field, where the electrons are turned at an angle of 180 degrees, and are again returned to the resonator. The electrons must pass the resonator each time at the maximum of a standing wave, and each time the electrons receive an energy eV cos θ. In the process of acceleration the electrons undergo phase and betatron oscillations about an equilibrium orbit. An analysis of the stability of the phase oscillations shows that the phase trajectories have the form of spirals. This behavior indicates that the phase oscillations are dampened with an increase in energy. There are lower and upper limits to values of equilibrium phase. At V = 400 kilovolts the optimum value of the equilibrium phase has a region of stability over 1.3 radians, that is, about 20% of the total cycle. A study of the effect of phase oscillations on the radial betatron oscillation shows that the acceleration is not disturbed. The results of this study indicate that with the use of this method of acceleration it is possible to create a 5 to 10 MeV accelerator having a large region of phase stability with a very single introduction and removal of electrons and ready means of identifying and turning the beam. (TTT)

52097 DESIGN OF AN ENERGY ANALYZER OF CHARGED PARTICLES FOCUSED BY A LONGITUDINAL MAGNETIC FIELD. Kozlov, I. G.; Kabanov, L. N. (Saratov State Univ.). Zh. Tekh. Fiz., 39: 1706-9(Sept. 1969). (In Russian).

The creation of a magnetic energy analyzer whose force lines would be a continuation of the magnetic lines of the focusing system is of interest in the energy analysis of charged particles. With this purpose an equation is found for the trajectory of a charged particle in an axially-symmetric magnetic field whose magnetic induction decreases exponentially. Numerical integration of this differential equation for the particle trajectories in various types of magnetic fields was carried out on an analog computer. The results are displayed graphically. Analysis of

the plots shows that focusing takes place in almost every case that was considered. The particle energies can be spread out by varying the strength of the magnetic field. An illustrative calculation shows a linear energy dispersion of 0.01 mm per volt. This linear dispersion determines the resolution of the energy analyzer, but the value quoted above is not an optimum value. (TTT)

52098 INCREASING INTENSITY OF HYDROGEN NEGATIVE ION AND ATOMIC BEAMS FROM A PULSED ION SOURCE. Dimov, G. I.; Savchenko, O. Ya. Zh. Tekh. Fiz., 38: 2002-4 (Nov. 1968). (In Russian).

Beams of particles of H^- and H^0 with intensities of 15 and 600 mA, respectively, were obtained at 13.5-keV with a source described previously (Zh. Tekh. Fiz., 38: 997 (1968)). With beam diameter of 2.5 cm the angular divergence did not exceed 0.02 radian. The pulse current duration was 100 μsec. Data obtained show that the reduced intensity and divergence of the beams is related basically to the geometry of the electric field in the extraction gap. (R.V.J.)

52099 SPHERICAL ABERRATION OF A SHORT QUADRUPOLE LENS TAKING INTO ACCOUNT THE INFLUENCE OF POLE AND ELECTRODE SHAPES. Ovsyannikova, L. P.; Chechulin, V. N.; Yavor, S. Ya. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekh. Fiz., 38: 1953-60(Nov. 1968). (In Russian).

General expressions for the coefficients of spherical aberrations of quadrupole lenses were obtained with the order of accuracy up to the fifth order with field varying along its optical axis. The influence of the non-linearity of the field, and the effects of its decrement at the lens edges on the quality of the image were estimated by short lens approximations. (R.V.J.)

52100 STABILITY CONDITIONS FOR PHASE MOTION OF RELATIVISTIC PARTICLE BUNCHES IN STORAGE RINGS. Karliner, M. M.; Skrinskii, A. N.; Shekhtman, I. A. (Inst. of Nuclear Physics, Novosibirsk, USSR). Zh. Tekh. Fiz., 38: 1945-52(Nov. 1968). (In Russian).

Voltage supplied to the accelerating system by grouped particle beam induced instability results in self-excited radial-phase oscillations. The conditions of stability which are in agreement with the conditions of arbitrary frequency characteristics of the accelerating system and which also take into account the straggling of the proper frequencies of the radial-phase oscillations of separate particles are obtained. The analysis is also expanded to the case in which the interactions of the beam with the acceleration system or other elements of the vacuum chamber take place at arbitrary harmonics of the conversion frequencies. (tr-auth)

52101 ACCELERATION OF MULTIPLY-CHARGED IONS BY COLLECTIVE METHOD. Iovnovich, M. L.; Rubin, N. B.; Sarantsev, V. P. At. Energ. (USSR), 27: 301-3(Oct. 1969). (In Russian).

A variant of the collective acceleration of multiply-charged ions is considered. The electron ring is formed in the axial symmetrical magnetic field increasing in time. Ion accumulation in the ring occurs due to the neutral atoms being ionized by electrons. Having been formed the electron-ion ring accelerated along the axis in the magnetic field falling in space. It is shown that a compact accelerator producing a beam of heavy ions of high intensity can be created by this method. (auth)

52102 POLICY AND PRACTICE FOR ACCELERATOR RADIATION SAFETY. Cowan, Frederick P. (Brookhaven National Lab., Upton, N. Y.). Nucl. Safety, 10: 483-91(Nov.-Dec. 1969).

As accelerators get into the Gev range (>1000 MeV), problems of dosimetry and personnel protection become more difficult. Strict personnel-control measures have been established for vaults and experimental areas for accelerators at Brookhaven (60 in. and Alternating Gradient Synchrotron), Oak Ridge (Isochronous), National Bureau of Standards, and Stanford. Problems of air and dust activation, external beams, tritium, and target handling are also encountered. Considerable latitude is required to meet local requirements. Although there should be no real compromise with safety, protective arrangements should be scaled to the degree of hazard and the local circumstances of each installation. For accelerators, as for other types of facilities, good results are based on the application of technical know-how and good common sense in planning and construction, as well as in operation. (auth)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 50223, 50528, 51793, 52058, and 52151.

52103 (CEA-R-3713) SPACE SYNTHESIS: AN APPLICATION OF SYNTHESIS METHOD TO TWO AND THREE DIMENSIONAL MULTIGROUP NEUTRON DIFFUSION EQUATIONS. Nguyen-Ngoc, Hoan (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). May 1969. 68p. (In French). Dep. CFSTI (U. S. Sales Only).

In order to reduce computing time, two- and three-dimensional multigroup neutron diffusion equations in cylindrical, rectangular (X, Y), (X, Y, Z) and hexagonal geometries are solved by the method of synthesis using an appropriate variational principle (stationary principle). The basic idea is to reduce the number of independent variables by constructing two or three-dimensional solutions from solutions of fewer variables, hence the name "synthesis method." Whatever the geometry, one is led to solve a system of ordinary differential equations with matrix coefficients to which one can apply well-known numerical methods: Chebyshev's polynomial method, Gaussian elimination. Numerical results furnished by synthesis programs written for the IBM 7094, the IBM 360-75, and the CDC 6600 computers, are confronted with those which are given by programs employing the classical finite difference method. (auth)

52104 (RPI-328-167) GROUP CONSTANT PREPARATION FOR THE ANALYSIS OF FAST NEUTRON SPECTRA. Becker, Martin (Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Nuclear Science). [1969]. Contract AT(30-3)-328. 6p. (CONF-691011-1). Dep. CFSTI.

From Seminar on Multigroup Cross Section Preparation: Theory, Techniques, and Computer Codes, Oak Ridge, Tenn.

Work on the problem of group constant preparation for highly resolved fast neutron and fast reactor energy spectra is described. The goal of the work is to test the adequacy of nuclear data and the treatment of the data in the energy range of importance to the analysis of fast reactors. Some improvements to the MC^2 code for spectrum calculations are described. (J.W.R.)

52105 NEUTRON SCATTERING RESULTS. Larsson, K. E. (Royal Inst. of Tech., Stockholm); Dahlborg, U.; Skoeld, K. pp 119-82 of Simple Dense Fluids. Frisch, H. L.; Salsburg, Z. W. (eds.). New York, Academic Press, Inc., 1968.

The method of scattering of slow neutrons is described as a technique in obtaining information concerning the dynamical behavior and the microscopic structure of the condensed state of matter. The results gained on four liquids, helium, argon, hydrogen, and methane, are reviewed. A terminology and a framework are established within which the results are discussed. (M.H.R.)

52106 OPTICAL OVERALL MODEL POTENTIAL FOR NEUTRON ELASTIC SCATTERING OF CALCIUM. Kin, L. F. .(National Tsing Hua Univ., Hsinchu, Taiwan). Ho Tsu K'o Hsueh, 6: No. 3-4, 9-21(Apr. 1969).

The purposes of this paper are to establish an axiomatic foundation of the optical model theory, to suggest a better fitting procedure for determining the parameters and to provide an overall optical model potential of calcium for neutron scattering. In the first section, the optical model potential was derived by the assumptions. In Section 2 the fitting procedure and recent analysis of the potential were discussed. Moldauer potential was employed for neutron energy below 1 MeV, both Engelbrecht-Fiedeldey Potential and Perey-Buck Potential for higher energies were discussed in Section 3. (auth)

52107 NEUTRON PHYSICS. Bacon, G. E. London, Wykeham Publications, 1969. 143p. 20s.

The following topics are discussed: Discovery of the neutron; sources of neutrons; properties of the neutron; neutron detection and energy measurement; reactions of neutrons; use of neutrons for studying solids; magnetism and magnetic materials; dynamics of solids and liquids; applications of neutron optics; absorption and neutron radiography. Some numerical questions are included. (UK)

Nuclear Properties and Reactions, A≤5

Refer also to abstracts 51958, 52095, and 52120.

52108 (ORO-3398-15) RESEARCH AND OPERATION OF THE TEXAS A AND M VARIABLE ENERGY CYCLOTRON. Progress Report, June 1, 1968-June 1, 1969. (Texas Agricultural and Mechanical Univ., College Station. Cyclotron Inst.). Contract AT(40-1)-3398. 100p. Dep. CFSTI.

CALCIUM-40—deuteron reactions (d,Li-6) at 50 MeV, angular distributions for (E)
—helium-3 reactions (He-3, Be-7) at 60 MeV, pulse height spectra for (E)
CYCLOTRONS—research and development at Texas A and M variable energy
DEUTERIUM—alpha reactions at 40 MeV, neutron energy spectra for (E)
OXYGEN-16—deuteron reactions (d, Li-6) at 50 MeV, angular distributions for (E)
STRONTIUM-88—deuteron reactions (d, He-3) at 35 MeV, helium-3 spectra for (E)
THULIUM-169—alpha reactions (α, t) at 40 MeV, triton spectra for (E)
YTTRIUM-89—deuteron reactions (d, He-3) at 35 MeV, helium-3 spectra for (E) (J.W.R.)

52109 (RLO-1388-96) ANNUAL REPORT [ON NUCLEAR PHYSICS]. (Washington Univ., Seattle. Nuclear Physics Lab.). June 1969. Contract AT(45-1)-1388. 166p. Dep. CFSTI.

CARBON-10—beta decay of, γ spectra for (E)
CARBON-12—alpha inelastic scattering at 22.8 MeV, differential cross sections and γ circular polarization for (E)
—helium-3 inelastic scattering at 22 MeV, DWBA analysis for spin-flex probability in (T)
—energy levels from nitrogen-14 (d, α) reactions,(E)
COPPER-65—alpha reactions at 42 MeV with compound nucleus formation, γ spectra for (E)
COPPER—alpha reactions at 42 MeV with compound nucleus formation, γ spectra for (E)
CYCLOTRONS—experimental facilities at University of Washington
GERMANIUM-72—deuteron reactions (d, p) at 11 MeV, DWBA analysis of (E/T)
GERMANIUM-73—energy levels from germanium-72 (d, p) reactions, spectroscopic factors for (E)
GOLD-197—alpha inelastic scattering at 65 MeV, DWBA analysis for spin-flip probability in (T)
—alpha inelastic scattering at 90 MeV α spectra for (E)
—alpha reactions (α, He-3) at 90 MeV helium-3 spectra for (E)
—helium-3 inelastic scattering at 75 MeV, helium-3 spectra for (E)
—helium-3 reactions (He-3, α) at 75 MeV, α spectra for (E)
HELIUM-3—deuteron elastic scattering at 10 to 18 MeV, excitation functions for (E)
—deuteron reactions (d, α) at 10 to 18 MeV, excitation functions for (E)
LEAD-208—proton inelastic scattering at 18 to 24 MeV, excitation functions for (E)
—proton reactions (p, np) at 22 to 23 MeV, delayed proton spectra for (E)
—proton reactions (p, d) and (p, t) at 18 to 24 MeV, excitation functions for (E)
LITHIUM-7—deuteron reactions (d, He-3) and (d, t) at 24 and 23 MeV, helium-3 and triton energy spectra for (E)
—proton reactions (p, d) at 23 MeV, angular distributions for (E)
MAGNESIUM—deuteron inelastic scattering at 12 MeV, DWBA analysis for spin-flip probability in (T)
MOLYBDENUM-92—deuteron reactions (d, p) near 7 MeV, angular distribution for (E)
MOLYBDENUM-94—deuteron reactions (d, p) near 7 MeV, angular distribution for (E)
NITROGEN-14—deuteron reactions (d, α) at 20 MeV, DWBA analysis of (E/T)
PLUTONIUM-240—fission of isomeric, half-life for spontaneous (E)
PROTONS—interactions p + p → p + p + γ at 20 MeV, bremsstrahlung spectra from (E)
RADIUM-226—proton fission at 13 MeV, α spectra for (E)
THALLIUM-205—deuteron reactions (d, p) at 10 to 19 MeV with isobaric analog excitation, excitation functions for (E)
—proton elastic and inelastic scattering at 12 to 18 MeV with isobaric analog excitation, excitation functions for (E)
THORIUM-230—proton fission at 13 MeV, α spectra for (E)

URANIUM-233—proton fission at 14 MeV, mass and neutron yields for (E)
URANIUM-238—proton fission at 11.5 and 22 MeV, mass and neutron yields for (E)
VAN de GRAAFF ACCELERATORS—research and development at University of Washington tandem
ZINC-64—proton reactions (p, t) at 20.5 MeV, angular distribution for (E)
—alpha reactions at 42 MeV with compound nucleus formation, γ spectra for (E)
ZIRCONIUM-90—deuteron reactions (d, p) near 7 MeV, angular distribution for (E) (J.W.R.)

52110 THE d–d REACTIONS BELOW 500 keV. Boersma, H. J. (Vrije Univ., Amsterdam). Nucl. Phys., A135: 609-31 (1969).

The d(d,n)^{3}He and d(d,p)T reactions are studied for deuteron energies below 500 keV. The semi-phenomenological model of Konopinski and Teller is criticized and shown to be applicable to at most a few hundred keV. A new, simpler and in principle quantitative description is given for these energies. The low-energy data are analyzed qualitatively. The energy dependence of the cross sections and the ratio of the cross sections for both reactions can very well be described in this way. It was rediscovered that the ratio A_2/A_0 of anisotropy coefficients ought not to be zero at zero deuteron energy, thus the cross section not isotropic, and the data of Eliot and Theus agree now very well. Moreover, the polarization of the outgoing nucleons must not necessarily vanish in the limit of zero deuteron energy. With regard to the experiments with a polarized deuteron beam it is not necessary to assume a narrow resonance at about 100 keV. A simplified quantitative calculation with Hamada and Johnston potentials gives a l = 1 contribution in the cross sections that is too small. This supports the assumption of large effects of the negative parity states of the α-particle at 21.4 (0^-) and 22.4 (2^-) MeV. (auth)

Nuclear Properties and Reactions, 6 ≤ A ≤ 19

Refer also to abstracts 49823, 51865, 51975, 52108, 52109, 52120, 52174, and 52179.

52111 (CEA-R-3807) RECOIL SPECTRA PRODUCED BY 14.1 MeV NEUTRONS. Clayeux, Genevieve; Grenier, Gerard (Commissariat a l'Energie Atomique, Limeil-Brevannes (France). Centre d'Etudes). Aug. 1969. 37p. (In French). Dep. CFSTI (U. S. Sales Only).

Recoil spectra produced by 14.1-MeV neutrons on the following substances have been studied: carbon, nitrogen, oxygen, aluminum, iron, and lead. The detection was made at 90° to the incident neutron direction using a Ge (Li) detector. Values of the differential cross sections at 90° for the most important gamma rays are given expressed in mb/sr. (auth)

52112 (INR-1094) ENERGY DEPENDENCE OF THE POLARIZATION IN DIRECT REACTION. Kozlowski, M. (Institute of Nuclear Research, Warsaw (Poland)). 1969. 14p. Dep. CFSTI (U. S. Sales Only).

An analysis is made of the polarization of protons from the reaction ^{9}Be(d,p)^{10}Be. It is shown that the predictions based on the invariance of the density matrix under the exchanging of the distorted waves (when $|\vec{p}_d| = |\vec{p}_p|$) are in the qualitative agreement with the experimental data. The usefulness of the DWBA for the describing of the polarization in the energy range 2 to 10 MeV is also discussed. (auth)

52113 YIELD OF DEUTERONS KNOCKED OUT FROM THE ^{12}C NUCLEUS BY 730 AND 1260 MeV PROTONS. Borisov, V. S.; Bysheva, G. K.; Gol'din, L. L.; Kondrat'ev, L. N.; Smorodinskaya, I. Ya.; Tumanov, G. K. JETP Lett. (USSR) (Engl. Transl.), 9: 413-6(June 20, 1969).

Translated from Zh. Eksp. Teor. Fiz., Pisma Redaktsiyu, 9: 667-71(June 20, 1969).

The yield of deuterons from 730- and 1260-MeV proton reactions with the carbon-12 nucleus near the maximum of backward elastic p + d scattering is studied. The measurements were made using a scintillation-counter hodoscope. The obtained spectra are shown as the deuteron momentum versus the differential deuteron-emission cross section per unit solid angle and per unit deuteron momentum interval. It is pointed out that the irregularity of the spectrum near the backward elastic p + d scattering shows that the quasielastic deuterons are knocked out of the carbon-12 nucleus by the incident protons. Deuteron widths were also calculated from the data. (J.F.P.)

52114 PROTON PRODUCTION FROM NUCLEI BOMBARDED BY PROTONS OF 1, 2, AND 3 BeV. Edge, R. D. (Univ. of South Carolina, Columbia); Tompkins, D. H.; Glenn, J. W. Phys. Rev., 183: 849-53(July 20, 1969).

The momentum spectra of protons emitted from Be, C, Cu, and Pb nuclei bombarded by 1-, 2-, and 3-BeV protons from the Cosmotron were measured at angles of 0, 17, and 32°. After correcting for scattering in the detectors, the spectra show reasonable agreement with Monte Carlo calculations of Bertini. However, the dependence on mass number A requires a much larger value for the exponent of A than is predicted by theory. (auth)

52115 STUDY OF ^{14}N BY SEVERAL TRANSFER REACTIONS. Holbrow, C. H.; Middleton, R.; Focht, W. (Univ. of Pennsylvania, Philadelphia). Phys. Rev., 183: 880-7(July 20, 1969).

Nitrogen-14 was studied by magnetic analysis of particles from the reactions ^{13}C(^{3}He,d)^{14}N, ^{12}C(^{3}He,p)^{14}N, ^{16}O(d,α)^{14}N, and ^{15}N(^{3}He,α)^{14}N. Measured angular distributions and intensities are consistent with present spin, parity, and isospin assignments. Doublets were observed at 8.97 and 8.99 MeV, and at 10.06 and 10.10 MeV. Evidence is presented that the 7.97-MeV state is not negative-parity. Strong evidence suggests the 6.21- and 6.44-MeV states may be considered to arise by excitation of two particles to higher shell-model orbitals. Other qualitative configurational assignments are also made. (auth)

52116 LIFETIME OF THE FIRST EXCITED STATE IN ^{19}F. Mendelson, R. A. Jr.; Carpenter, R. T. (Univ. of Iowa, Iowa City). Phys. Rev., 183: 924-6(July 20, 1969).

The lifetime of the first excited state of ^{19}F was measured by electronic timing using the inelastic scattering of protons to excite the state. Timing signals for the particles were obtained from a solid-state detector which also provided energy selection. The γ-ray detector was a 2-mm-thick by 2.5-cm-dia Na(Tl) crystal viewed by an RCA-8575 photomultiplier. The result obtained for the mean lifetime was 0.91 ± 0.05 nsec. (auth)

52117 GAMMA-RAY WIDTHS IN ^{13}C, ^{6}Li, AND ^{31}P. Rasmussen, V. K.; Swann, C. P. (Franklin Inst., Swarthmore, Pa.). Phys. Rev., 183: 918-23(July 20, 1969).

The width of the 3.68-MeV level of ^{13}C was measured and found to be $\Gamma = 0.44 \pm 0.04$ eV. After correction for the E^3 dependence, this is 0.59 times as strong as the mirror transition in ^{13}N, in agreement with Morpurgo's prediction of approximate equality for M1, $\Delta T = 0$ transitions in mirror nuclei. The ^{13}C width was obtained from a comparison of the resonant scattering of bremsstrahlung by ^{13}C with that by the 3.51-MeV level of ^{31}P and the 3.56-MeV level of ^{6}Li. The widths of the ^{31}P and ^{6}Li levels were measured in self-absorption experiments, and found to be 52 ± 8 MeV and 8.1 ± 0.5 eV, respectively. A limit on the energetically allowed but spin- and parity-forbidden decay of the ^{6}Li level to α + d was established as $\Gamma_{\alpha d} < 1.3$ eV. (auth)

52118 INELASTIC ELECTRON SCATTERING AND THE CLUSTER MODEL OF ^{6}Li. Aurdal, A. (NORDITA, Copenhagen); Bang, J.; Hansteen, J. M. Nucl. Phys., A135: 632-46(1969).

Alpha-deuteron cluster wave functions for ^{6}Li generated in a Saxon–Woods potential are applied to inelastic electron scattering. The idea of the clusters being predominantly in a relative 2S state is adopted. The quadrupole transition from the ^{6}Li ground state to the 2.184-MeV level is studied within this picture. Form factors in excellent agreement with existing experimental data are obtained. It is shown that the recently observed continuous cross section underlying the first few electron-excited levels in ^{6}Li cannot be ascribed to an alpha-deuteron break-up of the monopole type. It is pointed out that the possibility of observing the monopole alpha-deuteron break-up exists in a region of excitation energies from the threshold up to about 2 MeV. (auth)

Nuclear Properties and Reactions, 20 ≤ A ≤ 89

Refer also to abstracts 49823, 51375, 51841, 51865, 52108, 52109, 52111, 52114, 52117, 52143, 52169, and 52179.

52119 (AE-366) NEUTRON ELASTIC SCATTERING CROSS SECTIONS. EXPERIMENTAL DATA AND OPTICAL MODEL CROSS SECTION CALCULATIONS. A Compilation of Neutron Data from the Studsvik Neutron Physics Laboratory. Holmqvist, B.; Wiedling, T. (Aktiebolaget Atomenergi, Studsvik (Sweden)). June 1969. 211p. Dep. CFSTI (U. S. Sales Only).

Neutron elastic scattering cross section measurements have been going on for a long period at the Studsvik Van de Graaff laboratory. The cross sections of a range of elements were investigated in the energy interval 1.5 to 8 MeV. The experimental data were com-

pared with cross sections calculated with the optical model when using a local nuclear potential. (Sweden)

52120 (UCRL-18667, pp 65-132) NUCLEAR REACTIONS AND SCATTERING. (California Univ., Berkeley. Lawrence Radiation Lab.).

BERYLLIUM-8—energy levels from $\alpha-\alpha$ elastic scattering, spin-parity assignments for (E)
BISMUTH-209—deuteron reactions (d,He-3) at 50 MeV, helium-3 spectra for (E)
CALCIUM-40—proton elastic scattering at 20 MeV using polarized beams, optical-model analysis of (E/T)
FLUORINE-19—energy levels from (p,t) and (p,He-3) reactions, spin-parity assignments for isobaric analog (E)
FLUORINE-20—energy levels from (p,t) and (p,He-3) reactions, spin-parity assignments for isobaric analog (E)
HELIUM-3—proton elastic scattering at 10 to 20 MeV, cross section and polarization for (E)
HELIUM-4—alpha elastic scattering by, phase shift analysis of (E)
IRON-54—proton inelastic scattering at 19.6 MeV using polarized beams, asymmetry, cross section, and spin-flip probability for (E)
IRON-56—proton inelastic scattering at 19.6 MeV using polarized beams, asymmetry, cross section, and spin-flip probability for (E)
LEAD-208—energy levels from bismuth-209 (d,He-3) reactions, proton particle-hole (E)
—proton reactions (p,α) at 35 MeV, α spectra for (E)
MAGNESIUM-23—energy levels from (p,t) and (p,He-3) reactions, spin-parity assignments for isobaric analog (E)
MAGNESIUM-24—energy levels from (p,t) and (p,He-3) reactions, spin-parity assignments for isobaric analog (E)
—energy levels from α inelastic scattering, unnatural-parity (E)
—alpha inelastic scattering at 50 to 120 MeV spectra and angular distributions for (E)
—alpha elastic and inelastic scattering at 24 to 40 MeV, excitation functions for (E)
NEON-19—energy levels from (p,t) and (p,He-3) reactions, spin-parity assignments for isobaric analog (E)
NEON-20—energy levels from (p,t) and (p,He-3) reactions, spin-parity assignments for isobaric analog (E)
NEUTRONS—interactions n + n, determination of effective range parameters from final-state interaction in tritium (d,He-3) reactions (E)
—interactions n + p in nuclear shell-model configurations (T)
NUCLEAR MODELS—shell, proton-neutron residual interactions in (T)
NUCLEI—neutron-proton residual interactions in shell-model configuration (T)
SODIUM-23—energy levels from (p,t) and (p,He-3) reaction, spin-parity assignments for isobaric analog (E)
SODIUM-24—energy levels from (p,t) and (p,He-3) reactions, spin-parity assignments for isobaric analog (E)
THALLIUM-205—energy levels from lead-208 (p,α) reactions, (E)
—proton inelastic scattering at 20 MeV, spectra for (E)
TRITIUM—deuteron reactions (d,He-3) at 31.9 MeV, analysis of final-state interaction in (E) (L.T.W.)

52121 GAMMA-RAY SPECTRA FOR (n,γ) REACTIONS OF THERMAL NEUTRONS IN ^{74}Se, ^{76}Se, AND ^{77}Se NUCLEI. Rudak, E. A.; Firsov, E. N.; Khil'manovich, A. M. (Inst. of Physics, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk, No. 4, 116-20(1969). (In Russian).

Gamma-ray spectra for (n,γ) reaction of thermal neutrons in separated ^{74}Se, ^{76}Se, and ^{77}Se specimens were studied by means of a Compton magnetic spectrometer with a resolving power of 2%. The method and characteristics of the experiments are tabulated as well as the energy and intensity (in γ quanta numbers) for 100 neutron captures. (R.V.J.)

52122 LOW-ENERGY SECONDARY PARTICLES PRODUCED BY NUCLEAR INTERACTIONS OF 19.8-GeV/c PROTONS. Beaujean, R.; Roehrs, H. (Univ., Kiel). Z. Phys., 228: 308-21(1969). (In German).

A study of heavy secondary particles generated by 19.8 GeV/c proton interactions is presented. Energy spectra, angular distribution and relative abundances of these particles are determined. Indications are found for a forward motion of the target nucleus and for multiple collisions in heavy nuclei. (auth)

52123 DECAY OF ^{63}Co AND ^{64}Co. Ward, T. E.; Pile, P. H.; Kuroda, P. K. (Univ. of Arkansas, Fayetteville). J. Inorg. Nucl. Chem., 31: 2679-84(Sept. 1969).

A new 0.40 ± 0.05 sec activity which was observed to have a β end-point energy of 7.0 ± 0.5 MeV was assigned to ^{64}Co. The assignment of a 26 ± 1 sec activity with a single γ-ray of 86.3 ± 0.7 keV and a coincident β-ray of 3.6 ± 0.2 MeV was made to ^{63}Co. (auth) (UK)

52124 PHOTONEUTRON CROSS SECTION FOR ^{27}Al. Costa, S. (Univ., Turin. Istituto Nazionale di Fisica Nucleare, Turin); Ferrero, L.; Pasqualini, L.; Manfredotti, C. Nuovo Cim., Lett., 2: 318-22(Sept. 1, 1969).

The photoneutron cross section of ^{27}Al was measured in the giant resonance region (15 to 35 MeV) with BF_3 proportional counters. The structure in the cross section was compared with the ^{28}Si(γ,n) reaction, studied under the same experimental conditions. The results are also compared with shell and collective model calculations. (J.W.R.)

52125 FAST NEUTRON CAPTURE BY VANADIUM AND TITANIUM. Dudey, N. D.; Heinrich, R. R.; Madson, A. A. (Argonne National Lab., Ill.). J. Nucl. Energy, 23: 443-56 (Aug. 1969).

Fast neutron capture cross sections of ^{51}V and ^{50}Ti were measured by the activation method as a function of neutron energy between about 150 keV and 1.7 MeV. These cross sections were measured relative to both the ^{235}U(n,f) cross section and the ^{197}Au(n,γ)^{198}Au cross section. Neutrons were produced by the ^{7}Li(p,n)^{7}Be reaction from a Van de Graaff accelerator. The uncertainties on the absolute activation cross sections are ±8.5% for ^{51}V and ±9.9% for ^{50}Ti and were evaluated with the aid of a computer code which is described. A complete error analysis is given. The data were compared with calculations based upon the statistical compound nucleus model of nuclear reactions. The significant feature of the measured reactions is the sizeable fluctuations of the cross section about a smooth average which cannot be described by the theoretical calculations. Possible explanations for this observed structure are given. (auth)

52126 EXPERIMENTAL PROBLEMS IN THE DOPPLER-SHIFT ATTENUATION METHOD. Currie, W. M.; Earwaker, L. G.; Martin, J. (Atomic Energy Research Establishment, Harwell, Eng.). Nucl. Phys., A135: 325-34(1969).

The lifetime of the first excited state of ^{30}Si was measured by the Doppler-shift attenuation method using Mg, SiO_2, Y, Sn, Ni and Au as stopping media. Comparison of the different results shows that the major uncertainty in such measurements stems from the inadequacies of present stopping power theory and that the rms error arising from this source will be ≈15% in a typical measurement. The measured lifetime is taken as 0.336 ± 0.025 ps. (auth)

52127 A STUDY OF LEVELS OF ^{27}Mg BY THE ^{26}Mg(d,pγ)^{27}Mg REACTION. Sykes, D. H.; Olsen, W. C.; Hutcheon, D. A.; Vermette, C. W.; Sheppard, D. M.; Sowerby, B. D.; Twin, P. J. (Univ. of Alberta, Edmonton). Nucl. Phys., A135: 335-48(1969).

Spins of levels in ^{27}Mg below 5 MeV and the branching ratios and multipole mixing parameters of their gamma decays were investigated using the ^{26}Mg(d,pγ)^{27}Mg reaction and method II of Litherland and Ferguson. The present results combined with previous work lead to an assignment of $J^{\pi} = 3/2^+$ for the 3.782-MeV level and $J = 1/2$ for the 3.757 MeV level. The spins of the 3.109- and 4.394-MeV levels were limited to $J = 3/2$ or $1/2$ and $J = 3/2$, $5/2$ or $9/2$, respectively. Several previously known spins were confirmed. The decay modes of most of the levels up to $E_x \approx 5$ MeV were determined. The experimental data are compared with the predictions of the Nilsson model and shell model. (auth)

52128 PARTIAL RADIATIVE CAPTURE OF RESONANCE NEUTRONS IN Cl, Mn, Fe, Cu, Tm, AND Hg. Alves, R. N.; Kuchly, J. M.; Julien, J.; Samour, C.; Morgenstern, J. (CEN, Saclay, France). Nucl. Phys., A135: 241-80(1969). (In French).

Gamma-ray spectra of radiative neutron capture was studied in some nuclei with the Saclay linear accelerator using the time-of-flight method and a Ge(Li) detector. Level schemes from neutron resonances allow the assignment of spin values in a few cases. This study puts in evidence M1 transitions in ^{35}Cl + n. New levels not previously observed are found for other nuclei. (auth)

52129 MEASUREMENTS OF THE MEAN LIVES OF THE FIRST EXCITED STATES OF ^{32}S. Thibaud, J. P.; Aleonard, M. M.; Castera, D.; Hubert, P.; Leccia, F.; Mennrath, P. (Univ., Bordeaux). Nucl. Phys., A135: 281-8(1969). (In French).

Doppler-shift measurements of γ-rays from the ^{31}P(p,γ)^{32}S reaction lead to the mean lifetimes τ_m = 260 ± 80, 50 ± 13, 170 ± 100, 250 ± 50, 68 ± 12, 61 ± 15 and >1000 fs for the levels ^{32}S* = 2.237, 4.287, 4.698, 5.012, 5.553, 6.226 and 6.621 MeV, respectively. The experimental electromagnetic transition rates are compared with those calculated with the asymmetric model of Davydov and Filippov. The level schemes of ^{16}O, ^{24}Mg and ^{32}S have analogous characteristics. (auth)

52130 ISOMERIC RATIOS FOR THE REACTIONS ^{85}Rb(n,2n)^{84m,g}Rb AND ^{85}Rb(γ,n)^{84m,g}Rb. Kneissel, U.; Schneider, H.; Voelpel, R.; Woelcken, K. (Justus Liebig-Univ., Giessen, Ger.). Nucl. Phys., A135: 395-400(1969). (In German).

The decay of ^{84m,g}Rb was investigated with a Ge(Li) gamma-spectrometer. Isomeric cross-section ratios were measured for the reactions ^{85}Rb(n,2n)^{84m,g}Rb and ^{85}Rb(γ,n)^{84m,g}Rb. Using the method of Huizenga and Vandenbosch, values of the spin cut-off parameter of the nuclear level density were deduced from the measured ratios. (auth)

52131 STUDY OF THE NEUTRON–PROTON CORRELATIONS IN THE SHELL MODEL. Shah, Jyoti A. (Institut fuer Theoretische Physik, Frankfurt am Main); Danos, Michael. Phys. Rev., 183: 899-907(July 20, 1969).

A shell-model treatment is given for the spectra of the nuclei where there are two protons and two neutrons outside a doubly closed shell. The only restriction is that like-nucleons are required to occupy the same angular momentum state. In addition to this general wave function, more restricted wave functions also are investigated, viz., the pairing wave function (at least one pair of like nucleons is coupled to zero angular momentum) which contain no n-p correlations; the quartetting wave function (two unlike nucleons are first coupled to the maximum angular momentum, then the two pairs are coupled to I, the nuclear angular momentum) which does contain n-p correlations; and a superposition of pairing and quartetting wave functions. Results for ^{44}Ti, ^{64}Zn, and ^{204}Hg are given. The ground states are reproduced quite well by the pairing wave function; it seems, however, to fail for the excited states. The overlap between the general and the quartetting wave function is quite large. Finally, results are also given for the pairing force, which has only a T = 1 component. (auth)

52132 HARTREE–FOCK–BOGOLYUBOV CALCULATIONS IN THE 2s, 1d SHELL. Satpathy, L. (Saha Inst. of Nuclear Physics, Calcutta); Goss, D.; Banerjee, M. K. Phys. Rev., 183: 887-98 (July 20, 1969).

Ground-state properties were studied for N = Z, N = Z + 2, and N = Z + 4 even-even nuclei for which both neutrons and protons fill the 2s, 1d major shell, using the Hartree–Fock–Bogoliubov theory. The mass quadrupole moments and moments of inertia relative to the intrinsic reference frame are calculated, and qualitative features of the intrinsic deformations are discussed. Comparison is made to the results obtained when pairing correlations are absent, i.e., the Hartree–Fock predictions. The Hartree–Fock–Bogoliubov calculation yields the Hartree–Fock results for N = Z even-even nuclei. (auth)

52133 ISOBARIC ANALOG STATES AND COULOMB DISPLACEMENT ENERGIES IN THE ($1d_{\frac{5}{2}}$) SHELL. Hardy, J. C. (Univ. of California, Berkeley); Brunnader, H.; Cerny, Joseph; Jaenecke, J. Phys. Rev., 183: 854-68(July 20, 1969).

The (p,t) and (p,^{3}He) reactions were used to locate three previously unknown T = ½ isobaric analog states in ^{19}F, ^{19}Ne, and ^{23}Mg, in addition to significantly improving the precision on the energies of the T = ½ state in ^{23}Na and the T = 2 states in ^{20}F and ^{24}Na. These multiplets all lie within the "($1d_{\frac{5}{2}}$) shell" in that they have fewer than n = 12 nucleons outside ^{16}O, and T ≤ minimum (½n, 6 − ½n). Including these data, twenty-eight displacement energies are now known throughout this shell for all possible multiplets with T ≤ 2 (except T = 2, mass-22). The experimental displacement energies were compared in detail with calculations which used Hecht's Coulomb-energy equations; the excellent agreement obtained appeared to be relatively insensitive to the assumed nuclear wave functions since both the low-seniority j-j coupling limit and the Wigner supermultiplet scheme produced similar results. Four parameters related to the two-body Coulomb-energy matrix elements were treated as adjustable in fitting the data but their final values are in reasonable agreement with matrix elements calculated using harmonic-oscillator wave functions. A fifth adjustable parameter took account of the Z and N dependence of the charge radius. Using the experimental parameters, the unmeasured masses of ^{19}Na, ^{20}Mg, ^{21}Mg, ^{22}Al, ^{23}Al, ^{24}Si, and ^{25}Si are predicted, together with the excitation energies of unobserved analog states in the $1d_{\frac{5}{2}}$ shell. (auth)

52134 PHOTONEUTRON CROSS SECTIONS FOR ALUMINUM AND SILICON TO 62 MeV. Anderson, D. W.; Bureau, A. J.; Cook, B. C.; Englert, T. J. (Ames Lab., Iowa). Phys. Rev., 183: 978-82(July 20, 1969).

Photoneutron cross sections for ^{27}Al and ^{28}Si were measured from threshold to 62 MeV using least-structure analysis of the bremsstrahlung activation curves. The aluminum yield was due to the reactions ^{27}Al(γ,n)^{26*}Al and ^{27}Al(γ,2n)^{25}Al. Secondary maxima in the aluminum cross section, occurring at energies beyond the giant resonance, peak at 49.4 ± 0.8 and 56.3 ± 0.9 MeV. The cross section integrated to 62 MeV is 69 ± 4 MeV mb. The silicon yield was due to the ^{28}Si(γ,n)^{27}Si, ^{28}Si(γ,2n)^{26}Si, and ^{28}Si(γ,pn)^{26*}Al reactions. Peak energies for secondary maxima are 40.1 ± 0.9, 46.4 ± 0.8, 52.5 ± 0.8, and 58.2 ± 1.0 MeV. The integrated cross section is 195 ± 7 MeV mb. (auth)

52135 ELECTROMAGNETIC TRANSITION RATES IN ^{58}Ni. Bertin, M. C. (Rutgers–The State Univ., New Brunswick, N. J.); Benczer-Koller, N.; Seaman, G. G.; MacDonald, Jack R. Phys. Rev., 183: 964-77(July 20, 1969).

Lifetimes of 15 excited states in ^{58}Ni and one in ^{62}Ni were measured using the Doppler-shift-attenuation method. The levels were excited via inelastic proton scattering at bombarding energies from 7 to 9 MeV. The Doppler shifts of decay γ rays were measured in a 30-cm^3 Ge(Li) detector in coincidence with particles backscattered near 170°. Theoretical estimates of stopping powers were checked experimentally by Doppler-shift-attenuation measurements; excellent agreement was found. The matrix elements extracted from the measured lifetimes are compared with shell-model and vibrational-model predictions. Agreement is, in general, poor. The theoretical analysis indicates that a state-dependent neutron effective charge must be taken into account, and that core excitations play an important role in the determination of transition probabilities. (auth)

52136 FAST-NEUTRON SCATTERING FROM GERMANIUM. Lister, D.; Smith, A. B. (Argonne National Lab., Ill.). Phys. Rev., 183: 954-63(July 20, 1969).

Elastic and inelastic neutron scattering cross sections of natural germanium were measured in the incident neutron energy range 0.3 to 1.5 MeV with incident energy resolutions of ~20 keV. Neutron-velocity and γ-ray spectroscopic methods were employed to resolve the scattering to individual low-lying states. The results were interpreted in terms of the optical model and the statistical compound-nucleus model including effects due to fluctuations and correlations of resonance widths. Measured cross sections for inelastic scattering to a number of excited states in even Ge isotopes were reasonably well described by the statistical model of Hauser and Feshbach without corrections for width fluctuations and correlations. (auth)

52137 REACTION MECHANISMS IN ^{56}Fe(p,p′) FROM 5 TO 6 MeV. Nichols, D. B.; Arns, R. G.; Hausman, H. J.; Seyler, R. G. (Ohio State Univ., Columbus). Phys. Rev., 183: 945-53(July 20, 1969).

Proton angular distributions and spin-flip angular correlations were measured as absolute cross sections for inelastic scattering of 4.96-, 5.58-, and 5.88-MeV protons to the first excited (2^+) state at 0.847 MeV in ^{56}Fe. The spin-flip measurements involve directional correlation of the 0.847-MeV γ rays, detected along a perpendicular to the reaction plane, with the inelastic protons observed at angles from 30 to 150° in the reaction plane. The spin-flip probability was determined for the three energies studied. The measured cross sections are compared with the predictions of the statistical model and the direct-interaction model. The compound-nucleus mechanism appears to dominate the reaction in this energy range. The statistical-model predictions, which are based on optical-model parameters obtained at somewhat higher energies, give the correct shape and order of magnitude, but fail to fit simultaneously both the angular distributions and the spin-flip correlation data. (auth)

52138 ^{73}Ge(n,γ)^{74}Ge GAMMA-RAY SPECTRUM AND ENERGY LEVELS OF ^{74}Ge. Magruder, A. P.; Smither, R. K. (Argonne National Lab., Ill.). Phys. Rev., 183: 927-44(July 20, 1969).

The γ-ray spectra resulting from thermal-neutron capture in targets of natural germanium and enriched ^{73}Ge were measured with a Ge(Li) germanium detector. The energies and intensities of 85 γ rays in the energy range 0.20 to 3.00 MeV and 47 γ rays in the range 6.1 to 9.6 MeV were identified with the reaction ^{73}Ge(n,γ)^{74}Ge. The γ-ray spectrum was used to suggest four new levels, and place limits on the spins and parities of three other levels. Errors in the γ-ray energy values were reduced to less than 3 keV in all cases, and to less than 1 keV for many. Based on this experiment and other information, the energy levels identified below 3 MeV were 0.0 (0^+), 596.3 (2^+), 1204.9 (2^+), 1466.2 (4^+), [1486 (0^+)], [1697.7], 1699.3 ($3^\pm$, 4^+), 2168.3 ($3^\pm$, 4^+), 2200.2 (2^+), 2539.3 (3^-), 2574.1, 2672.4, [2695.8], 2699.1, 2833.2, 2929.2, 2939.7, and 2978.1 keV, where the levels in brackets were not fed directly from the capture state. The level energies were determined to within 1 keV. The energy of the capture state in the compound nucleus (^{73}Ge + n) was found to be 10,203.1 ± 0.9 keV. (auth)

52139 CORE-PARTICLE INTERACTION AND FRAGMENTATION OF SINGLE-PARTICLE LEVELS IN ^{41}Ca AND ^{41}Sc. Federman, P. (Franklin Inst., Swarthmore, Pa.); Greek, G.; Osnes, E. Nucl. Phys., A135: 545-60(1969).

The negative parity spectra of ^{41}Ca and ^{41}Sc are calculated using a simple phenomenological model in which a single nucleon in the 2p1f shell is coupled to the ground state and first rotational band in ^{40}Ca. The results are surprisingly good, the simplicity of the model taken into account. In particular, the observed fragmentation of the 2p1f single-particle levels is quite nicely reproduced, and good agreement is also obtained for the E2 transition rates. (auth)

52140 RESONANCES OF THE ^{26}Mg(p,γ) REACTION BETWEEN 660 and 1000 keV. Huang, F. C. P.; Ophel, T. R. (Australian National Univ., Canberra). Nucl. Phys., A135: 647-56(1969).

Gamma-ray spectra of the 661-, 719-, 809-, 839-, 954-, and 982-keV resonances of the ^{26}Mg(p,γ) reaction were obtained with a Ge(Li) detector. The decay schemes of the resonances and angular distribution measurements enabled tentative spin assignments to be made for the 3.678 ($\frac{1}{2}$)-, 5.552 ($\frac{1}{2}$)-, 5.751 ($\frac{1}{2}$)-, and 5.828 ($\frac{3}{2}$)-MeV levels. (auth)

Nuclear Properties and Reactions, A ≥ 90

Refer also to abstracts 51811, 51841, 51868, 51971, 52108, 52109, 52111, 52114, 52120, 52128, 52131, and 52176.

52141 (AWRE-O-55/69) NEUTRON SCATTERING BY ^{235}U AND ^{239}Pu FOR INCIDENT NEUTRONS OF 2, 3, AND 4 MeV. Batchelor, R.; Wyld, K. (Atomic Weapons Research Establishment, Aldermaston (England)). Aug. 1969. 16p. Dep. CFSTI (U. S. Sales Only). UK 2s. 6d.

The secondary neutron spectra resulting from the fast neutron bombardment of ^{235}U and ^{239}Pu were measured as a function of angle for 2, 3, and 4 MeV incident energies, using a time-of-flight spectrometer. The spectra were analyzed on an absolute basis for the elastic scattered, inelastic scattered and fission components. The 2 MeV runs show slight evidence that the fission component is harder than anticipated. (auth)

52142 (BNL-50151) OPTICAL MODEL ANALYSIS OF THE ELASTIC SCATTERING OF NEUTRONS BY THE LEAD ISOTOPES AND BISMUTH AT 0.5, 1.0, AND 2.5 MeV. Moore, S. O. (Brookhaven National Lab., Upton, N. Y.). Oct. 1968. 42p. Dep. CFSTI.

Total cross sections and differential elastic cross sections for neutron scattering on ^{206,207,208}Pb at 0.5, 1.0, and 2.5 MeV were analyzed using the optical model. A spin-dependent, diffuse-edge, local potential with surface absorption was used. The optical-model parameters obtained were used to analyze neutron scattering on ^{209}Bi in the same energy range. (J.W.R.)

52143 (UCRL-18667, pp 1-64) NUCLEAR SPECTROSCOPY AND RADIOACTIVITY. (California Univ., Berkeley. Lawrence Radiation Lab.).

ALUMINUM—chromium-48 recoil range in, from titanium-46 (α,2n) reactions (E)
BARIUM-130—isomeric transition in, γ spectra for
CALCIUM—helium-3 reactions at 20 MeV, excitation function and yields for (E)
CHROMIUM-48—recoil range in aluminum from titanium-46 (α,2n) reactions (E)
ELEMENT ONE HUNDRED AND FOUR—search for alpha and spontaneous fission activity of (E)
GERMANIUM—helium-3 reactions at 20 MeV, excitation function and yields for (E)
LUTETIUM-162—decay of, half-life for (E)
LUTETIUM-164—decay of, half-life for (E)
LUTETIUM-166—decay of, half-life for (E)
MAGNESIUM—helium-3 reactions at 20 MeV, excitation functions and yields for (E)
MOLYBDENUM-94—energy levels of, spin-parity assignments for
MOLYBDENUM-96—energy levels of, spin-parity assignments for
MOLYBDENUM-98—energy levels of, spin-parity assignments for
NEODYNIUM-134—isomeric transition in, γ spectra for
NICKEL—helium-3 reactions at 20 MeV, excitation functions and yields for (E)
NOBELIUM-258—fission of, half-life for spontaneous (E)
PLUTONIUM-238—alpha decay of, γ spectra for (E)
PROTACTINIUM-233—energy levels from neptunium-237 decay, reduced transition probabilities for (E/T)
RUTHENIUM-96—energy levels of, spin-parity assignments for
RUTHENIUM-98—energy levels of, spin-parity assignments for
RUTHENIUM-100—energy levels of, spin-parity assignments for
RUTHENIUM-102—energy levels of, spin-parity assignments for
SILICON—helium-3 reactions at 20 MeV, excitation functions and yields for (E)
THULIUM-158—decay of, half-life for (E)
THULIUM-160—decay of, half-life for (E)
TITANIUM—helium-3 reactions at 20 MeV, excitation function and yields for (E)
YTTERBIUM-158—decay of, half-life for (E)
YTTERBIUM-160—decay of, half-life for (E) (L.T.W.)

52144 (UCRL-18667, pp 168-81) FISSION. (California Univ., Berkeley. Lawrence Radiation Lab.).

CALIFORNIUM-252—fission of, γ spectra of product from spontaneous (E)
—fission of, x-ray spectra of products from spontaneous (E)
FISSION PRODUCTS—gamma spectra of, from californium-252 spontaneous fission (E)
—x-ray spectra of short-lived, from californium-252 spontaneous fission (E) (L.T.W.)

52145 A TECHNIQUE FOR THE ABSOLUTE COUNTING OF NUCLEAR FISSION EVENTS. Axton, E. J.; Bardell, A. G.; Audric, B. N. (National Physical Lab., Teddington, Eng.). J. Nucl. Energy, 23: 457-68(Aug. 1969).

A technique was developed for the absolute measurement of nuclear fission events which is virtually independent of any of the usual computed corrections for losses. The two fission products arising from each event were detected singularly and in coincidence, and the absolute fission rate was determined from the three recorded counting rates. The technique was developed as part of a program to determine $\bar{\nu}$ for ^{252}Cf. With a redesigned counter the method should be adaptable to the measurement of fission cross sections. (auth) (UK)

52146 RECOIL PROPERTIES OF ANTIMONY ISOTOPES PRODUCED BY THE REACTION OF 570 MeV AND 18.2 GeV PROTONS WITH URANIUM. Hageboe, E.; Ravn, H. (CERN, Geneva). J. Inorg. Nucl. Chem., 31: 2649-67(Sept. 1969).

Using the method of thick target and thick catchers, the ranges and other recoil properties of 13 (12) antimony isotopes between A = 115 and A = 131 (130) were measured for the reaction of 570 MeV (and 18.2 GeV) protons with uranium. The kinetic energies T are almost independent of product mass number at 570 MeV but show a strong dependence at 18.2 GeV, the lightest isotopes having only about half the kinetic energy of the heavy isotopes. The cascade deposition energies for production of antimony isotopes are almost equal at 570 MeV and 18.2 GeV, the lightest isotopes having only about half the kinetic energy of the heavy isotopes. The cascade deposition energies for production of antimony isotopes are almost equal at 570 MeV and 18.2 GeV and fit well to straight lines of the form $E^*(A,Z) = E^*(A_0,Z) + b(A-A_0)$. Exceptions were the cascade deposition energies for ^{115}Sb and ^{116}Sb, which seemed to be somewhat too high at 18.2 GeV. By comparison with other work it seems that the slope b of these lines is independent of product element, target and of proton irradiation energy above 450 MeV. If it is assumed that at 570 MeV the fissioning nucleus is a uranium isotope, the conclusion is that the average total kinetic energy of the primary fragments is smaller, and thus the average separation distance of their charge centers at scission larger, for the lightest antimony fragments than for the heaviest, the difference being about 10 per cent. (auth) (UK)

52147 DETERMINATION OF THE HALF-LIFE VALUE OF ^{204}Tl. Jordan, K. C.; Birden, J. H.; Blanke, B. C. (Monsanto Research Corp., Miamisburg, Ohio). J. Inorg. Nucl. Chem., 31: 2641-7(Sept. 1969).

The half-life of ^{204}Tl was determined to have a value of 3.7731 ± 0.0013 yr. This value was obtained from calorimetric measurements of the decay in power output of a sample of irradiated natural thallium over an 8-yr period. The average neutron flux on the thallium during irradiation was determined by the use of adjacent bismuth coupons. A value of 2.173 MeV-barn was obtained for ^{204}Tl for the product of the neutron cross section (σ) and particle average energy. Using the accepted cross section for ^{203}Tl of 11 barns for slow neutrons, the average energy of the β particles from ^{204}Tl becomes 0.1975 MeV. (auth) (UK)

52148 CALCULATIONS OF RADIATION WIDTHS IN (n,γ) REACTIONS. Belousova, V. I.; Knat'ko, V. A.; Rudak, E. A. (Inst. of Physics, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk, No. 4, 121-3(1969). (In Russian).

The forbidden factor for probabilities of one-particle γ-transitions in (n,γ) reaction was calculated. Comparisons of partial radiative width for E1-type transition at 4.059-MeV energy in

$^{238}U(n,\gamma)^{239}U$ reactions with given neutron width were tabulated. A similar comparison of partial radiative widths with neutron resonance widths for a large number of E1-type transitions in $^{169}Tm(n,\gamma)^{170}Tm$ reactions also did not reveal any correlation between the indicated magnitudes. (R.V.J.)

52149 DATE DETERMINATION OF SPONTANEOUS FISSION-PRODUCT FORMATION BY EMISSION OF ^{140}La GAMMA-RAYS. Silant'ev, A. N. At. Energ. (USSR), 27: 67-8(July 1969). (In Russian).

Date of instantaneous fission-product formation by emission of ^{140}La (1.6 MeV) γ rays was determined by measuring only the daughter isotope. In such a case the number of recorded pulses proportional to its activity is $n_2 = n_{01}\,[\lambda_1/(\lambda_2 - \lambda_1)]\,(e^{-\lambda_1 t} - e^{-\lambda_2 t})$, (where, n_2 and n_1 are the daughter isotope activity at the moment of measuring and the mother isotope at the moment of formation, respectively; λ_1 and λ_2 are the constants of the mother and daughter isotope decay, respectively, t is the time span from the moment of the isotope formation). The ratio of these magnitudes was measured at various time intervals after its formation, which is proportional to the activity of the isotope. The formula developed indicated that the ratio of measured intensities of ^{140}La (1.6 MeV) γ quanta is equal to the activity of the isotope and may be used for direct determination of instantaneous fission product formation. The period of ^{140}La is 1.68 days, so the method can be used at $t \leq 5$ to 7 days. (R.V.J.)

52150 TRANSITION RATES IN ^{161}Dy. Berg, V.; Malmskog, S. G. (Aktiebolaget Atomenergi, Studsvik, Sweden. Univ. of Stockholm). Nucl. Phys., A135: 401-18(1969).

The decay of ^{161}Tb was studied using a high-resolution Ge(Li) detector. Five new transitions were observed and fitted into the earlier proposed decay scheme. The half-life of the 131.8-keV level in ^{161}Dy was determined in a delayed-coincidence measurement to be 145 ± 15 psec. The low level scheme in ^{161}Dy is discussed within a quasiparticle model allowing for Coriolis mixing. Special attention is given to the strongly retarded, K-allowed 131.8-keV E1 transition with a retardation factor $F_w > 1.5 \times 10^6$. (auth)

52151 MEASUREMENT OF CROSS SECTION FOR THE $^{103}Rh(n,n')^{103m}Rh$ REACTION AND ITS APPLICATION TO FAST NEUTRON FLUX MEASUREMENTS. Kimura, Itsuro; Kobayashi, Katsuhei; Shibata, Toshikazu (Kyoto Univ.). J. Nucl. Sci. Technol. (Tokyo), 6: 485-93(Sept. 1969).

Making use of monoenergetic neutrons produced by a 2-MeV Van de Graaff accelerator, the cross section for the $^{103}Rh(n,n')^{103m}Rh$ reaction was measured in the energy range from 180 keV to 4.6 MeV. To obtain the relative activity of ^{103m}Rh, the 20 keV x-rays emitted by the nuclide were measured with a thin NaI(Tl) scintillator with Be window. For absolute measurement, a standard ^{103}Ru source was made from ruthenium trichloride irradiated with thermal neutrons. The self-shielding effect to the 20-keV x-rays was eliminated by the realization of a thin layer of Ru obtained by electrodeposition. The fission-spectrum-averaged cross section for this reaction determined by the present method is 558 ± 32 mb, and the effective cross section 960 ± 55 mb. The reaction was applied to the measurement of the fast neutron flux in the experimental facilities of the Kyoto University Reactor. The present report also gives a discussion on the advantage of using the $^{103}Rh(n,n')^{103m}Rh$ reaction as fast neutron radiation damage monitor. (auth)

52152 NUCLEAR SPINS OF NEUTRON-DEFICIENT HOLMIUM AND ERBIUM ISOTOPES. Ekstroem, C. (Univ. of Goteborg); Noreland, T.; Olsmats, M.; Wannberg, B. Nucl. Phys., A135: 289-309(1969).

The atomic-beam magnetic-resonance method was used to measure the nuclear spins of some neutron-deficient holmium and erbium isotopes with the following results: ^{154}Ho I = 1, ^{155}Ho I = 5/2, ^{156}Ho I = 1, ^{157}Ho I = 7/2, ^{158}Ho I = 5, ^{158m}Ho I = 2, ^{159}Ho I = 7/2, ^{160}Ho I = 5, ^{160m}Ho I = 2, ^{162}Ho I = 1, ^{162m}Ho I = 6, ^{164}Ho I = 1, ^{164m}Ho I = 6, ^{157}Er I = 3/2, ^{158}Er I = 0, ^{159}Er I = 3/2 and ^{161}Er I = 3/2. The investigated nuclei are located in a region of nuclear deformation and the nuclear spins are interpreted in terms of the unified nuclear model. (auth)

52153 FIRST-FORBIDDEN β-DECAYS IN THE LEAD REGION. Damgaard, J. (California Inst. of Tech., Pasadena); Broglia, R.; Riedel, Claus. Contract AT(04-3)-63. Nucl. Phys., A135: 310-24(1969).

Fourteen first-forbidden β-decays in the region around ^{208}Pb are analyzed in terms of only six unknown β-matrix elements between single-particle or single-hole states. Each of the matrix elements is of multipolarity $\lambda = 0$ or $\lambda = 1$ and is a combination of the usual first-forbidden matrix elements. The analysis gives experimental values for the six β-matrix elements and tests the consistency of the nuclear wave functions. The decay of ^{209}Tl is too fast by a factor of two as compared to the rest of the decays. The experimental values of the β-matrix elements are compared to values calculated with the β-interaction. (auth)

52154 MEASUREMENT OF α_K FOR THE 159 keV γ-RAY IN ^{117}Sn. Show, D. L.; Van Hise, J. R. (Andrews Univ., Berrien Springs, Mich.). Nucl. Phys., A135: 349-52(1969).

The K conversion coefficient of the 159-keV γ-ray in ^{117}Sn was measured by detecting the γ-ray and the K x-ray from conversion in a NaI(Tl) well detector in coincidence with the 565-keV γ-ray which feeds the 159-keV level. After the necessary corrections to the data, $\alpha_K = 0.110 \pm 0.012$. When this α_K is averaged with a previous measurement of α_K and then combined with a previously measured mixing ratio for the 159-keV transition, the nuclear structure parameter λ is found to be 4. (auth)

52155 MIXING RATIOS OF TRANSITIONS IN THE DECAY OF ^{192}Ir. Grabowski, Zbigniew W. (Purdue Univ., Lafayette, Ind.). Contract AT(11-1)-1746. Phys. Rev., 183: 1019-24(July 20, 1969).

Mixing ratios of the 485-keV transition in ^{192}Os and the 296-, 308-, and 604-keV transitions in ^{192}Pt populated from the decay of ^{192}Ir were measured using the γ-γ directional-correlation method. In addition the 468–316-keV, 589–612-keV, 885–316-keV, and 1063–316-keV γ-γ directional correlations in ^{192}Pt were remeasured. Coaxial and planar Ge(Li) detectors and NaI(Tl) scintillation detectors were used in different combinations depending on the energy resolution required for a particular measurement. The results for the mixing ratios are $\delta_{485} = +(10.9^{+2.2}_{-1.6})$, $\delta_{296} = -(9.1^{+2.7}_{-1.9})$, $\delta_{308} = -(9.9 \pm 1.0)$, and $\delta_{604} = +(2.0 \pm 0.2)$. The overall agreement of the signs, as well as the absolute values of the mixing ratios with predictions of the pairing-plus-quadrupole model of Kumar and Baranger, is good. (auth)

52156 LOW-LYING LEVELS OF ^{208}Pb WITH $g_{9/2}$, $i_{11/2}$, OR $j_{15/2}$ NEUTRON-PARTICLE CONFIGURATIONS. Richard, Patrick (Univ. of Washington, Seattle); von Brentano, P.; Weiman, H.; Wharton, W.; Weitkamp, W. G.; McDonald, W. W.; Spalding, D. Phys. Rev., 183: 1007-18(July 20, 1969).

The low-lying states of ^{208}Pb which have a neutron configuration $(g_{9/2}, j^{-1})$ are studied in proton scattering at the resonance energy for the $g_{9/2}$ (g.s.) single-neutron isobaric-analog resonance (IAR) in ^{209}Bi. The on-resonance proton angular distributions are taken from 15 to 170° for states between 3.0- and 4.5-MeV excitation in ^{208}Pb, and are found to be nearly symmetric about 90° except for the lowest 5⁻ (3.192-MeV) state. Total proton inelastic scattering cross sections and proton partial widths are obtained from the angular distributions. The states in the energy ranges 3.0 to 3.8, 3.8 to 4.15, and 4.15 to 4.8 MeV in ^{208}Pb are found to have the dominant neutron–neutron-hole configurations of $(g_{9/2}, p_{9/2}^{-1})$, $(g_{9/2}, f_{5/2}^{-1})$, and $(g_{9/2}, p_{3/2}^{-1})$, respectively. Some tentative spin assignments based on the partial widths, excitation energy, and angular distributions of the states are given. Two previously unreported states at 3.940 and 4.376 MeV in ^{208}Pb are observed in the high-resolution (p,p') spectrograph data, and the levels previously reported at 4.032 and 4.252 MeV are observed to be doublets with 12- and 6-keV energy separations, respectively. The cross sections were also measured for the (p,p') reaction at the $g_{9/2}$ resonance at 20, 40, 60, and 90° for 24 states between 4.6- and 6.00-MeV excitation. In addition to the $g_{9/2}$ resonance, the $i_{11/2}$ (0.79-MeV) IAR and $j_{15/2}$ (1.42-MeV) IAR are studied, and the observed states are compared with those observed in the $^{207}Pb(d,p)$ reaction. Partial widths for all the states between 2.0- and 4.5-MeV excitation containing $g_{9/2}$ neutron strength are calculated using the theoretical shell-model wave functions of Kuo and Brown and of Pinkston and True, and are compared with the experimentally observed widths. (auth)

52157 NEW ERBIUM ISOTOPE, ^{155}Er. Toth, K. S. (Oak Ridge National Lab., Tenn.); Hahn, R. L.; Roche, M. F.; Brenner, D. S. Phys. Rev., 183: 1004-6(July 20, 1969).

A new erbium isotope ^{155}Er was produced by bombarding enriched ^{156}Dy with α particles accelerated in the Oak Ridge Isochronous Cyclotron. In the experiments, recoil nuclei ejected from the thin target were collected on beryllium foils. After bombardment, the activity collected on the catchers was assayed with an α-particle Si(Au) spectrometer. The new isotope was found to have a half-life of 5.3 ± 0.3 min; its α-decay energy was measured to be 4.01 ± 0.03 MeV. The mass assignment of ^{155}Er was established by measuring an excitation function for its production for α-particle bombarding energies from 59.2 to 72.6 MeV. (auth)

52158 TRANSITIONS IN ^{107}Pd FOLLOWING 22-MIN ^{107}Rh DECAY. Griffin, Henry C. (Univ. of Michigan, Ann Arbor); Pierson, William R. Phys. Rev., 183: 991-1003(July 20, 1969).

The decay of ^{107}Rh was studied by γ-ray spectroscopy using Ge(Li) detectors and Ge(Li)-NaI(Tl) $\gamma\gamma$ coincidence techniques.

A decay scheme was constructed incorporating all but six of the 39 transitions reported. This decay scheme involves excited states in ^{107}Pd at 115.6, 302.8, 312.2, 348.2, 381.8, 392.5, 471.2, 567.7, 670.0, 1102, and 1148 keV. A half-life of 850 ± 100 nsec was found for the 115.6-keV level, and $\gamma\gamma$ delayed-coincidence spectroscopy was employed to determine the features of the decay scheme related to this level. β branching ratios and log ft values were derived from the relative γ-ray intensities and the β/γ ratio. The β decay of ^{107}Rh tends to avoid populating ^{107}Pd levels that have strong single-particle character [that is, levels populated strongly in (d,p) and (d,t) reactions]. (auth)

52159 THERMAL-NEUTRON-CAPTURE GAMMA RAYS IN ^{170}Yb, ^{172}Yb, AND ^{174}Yb. Namenson, A. I.; Ritter, J. C. (Naval Research Lab., Washington, D. C.). Phys. Rev., 183: 983-91 (July 20, 1969).

A Ge(Li) detector was used to investigate the γ spectra following thermal neutron capture in enriched isotope targets of ^{170}Yb, ^{172}Yb, and ^{174}Yb. In addition to capture in these isotopes, γ lines were identified as resulting from thermal capture in ^{171}Yb and ^{173}Yb. The neutron separation energies of ^{171}Yb, ^{172}Yb, ^{173}Yb, ^{174}Yb, and ^{175}Yb were found to be 6616, 8023, 6365, 7465, and 5819 keV, respectively. The experimental error is ±3 keV in all cases. For capture by the even-even isotopes, the energies and intensities of γ transitions originating from the capture state are presented together with the spins and Nilsson assignments of the low-lying rotational bands which they populate. The measurements are compared with those in other experiments, and the results of the measurements are discussed. Regularities in the decay of the capture state to low-lying Nilsson levels have now been observed in comparing thermal neutron capture by different even-even nuclei in the region A = 176. The regularities include relatively strong population of Nilsson bands with Λ equal to zero or 1 as compared to population of bands with Λ greater than 1. In addition, there seems to be a preference for the capture state decaying to particle rather than hole bands. A purely statistical version of thermal neutron capture would not seem to hold in this mass region. (auth)

52160 ANGULAR CORRELATION AND LIFETIME MEASUREMENTS IN ^{193}Ir. Badica, T.; Gelberg, A.; Protop, C.; Salageanu, S. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys., 14: 471-9(1969).

The excited states of ^{193}Ir from the decay of ^{193}Os were investigated by angular correlation and lifetime measurements. Several spins and mixing ratios were established. Several excited states were interpreted by de Shalit's core–excitation model. (auth)

52161 THE 371 keV $2^+ - 2^+$ TRANSITION IN ^{190}Os INVESTIGATED BY ELECTRON–ELECTRON AND GAMMA–ELECTRON DIRECTIONAL CORRELATIONS. Samuelsson, L.; Vukanovic, R.; Migahed, M.; Zupancic, M.; Edvardson, L. O.; Westerberg, L. (Uppsala Univ.). Nucl. Phys., A135: 657-77(1969).

Electron-electron directional correlation measurements were made on the 2^+ (371 keV) 2^+ (187 keV) 0^+ cascade in ^{190}Os and the magnitude of electric monopole to quadrupole mixing ratio for the 371-keV transition was determined to be $q_K(E0/E2) = -0.08(17)$ for $\lambda = 1$. To obtain this result it was necessary to use the gamma-ray spectrum following the electron capture decay of ^{190}Ir obtained using a Ge(Li) solid-state detector, the mixing ratio δ(E2/M1, 371 keV) = 6.5(13) calculated from a γ-e directional correlation measurement, the conversion coefficient α_K(371 keV) = 0.0375(17) measured by a coincidence method, the K/L_{III}(371 keV) = 15.8(5) measured in an iron-free double focusing spectrometer, and the half-life of the decay of iridium $T_{\frac{1}{2}}$ = 12.1(2) d. (auth)

52162 ELECTROMAGNETIC MOMENTS OF TRANSITIONS IN ^{191}Ir, ^{193}Ir FOLLOWING COULOMB EXCITATION. Avida, R.; Goldberg, M. B.; Goldring, G.; Sprinzak, A. (Weizmann Inst. of Science, Rehovoth, Israel). Nucl. Phys., A135: 678-88(1969).

Yield functions of de-excitation gamma rays following the Coulomb excitation of ^{191}Ir and ^{193}Ir by oxygen ions were measured. Reduced E2 and M1 transition probabilities were obtained for transitions among the low-lying levels: $\frac{3}{2}^+$ (ground state), $\frac{1}{2}^+$, $\frac{3}{2}^+$, $\frac{5}{2}^+$, $\frac{7}{2}^+$. The results are compared with the prediction of the core excitation model. (auth)

52163 PROTON PARTICLE-HOLE STATES IN ^{116}Sn FROM THE ^{115}In(^{3}He,d)^{116}Sn REACTION. Shoup, R. (Florida State Univ., Tallahassee); Fox, J. D.; Vourvopoulos, G. Nucl. Phys., A135: 689-95(1969).

The ^{115}In(^{3}He,d)^{116}Sn data taken with $E_{^3He}$ = 25.3 MeV are analyzed. The deuterons were detected in a broad-range spectrograph. Experimental resolution of 35 keV allowed the discrimination of individual levels in the energy range 3.7 to 4.9 MeV. These states are the multiplet members of the $(g_{\frac{9}{2}})^{-1}d_{\frac{5}{2}}$ particle-hole configuration mixed with core excited states which have a spacing of a few keV around 4 MeV excitation in ^{116}Sn. Most of the strength of the above particle-hole configuration is observed, and its centroid is calculated at E = 4.27 MeV excitation in ^{116}Sn. (auth)

52164 RPA CALCULATIONS IN THE CONTINUUM. I. CROSS SECTIONS FOR ^{207}(n,n')^{207*}Pb. Dover, Carl B.; Dietrich, Klaus (Univ., Heidelberg). Nucl. Phys., A135: 481-514(1969).

The elastic and inelastic cross sections for the reaction ^{207}Pb(n,n')^{207*}Pb between 1.5 and 7 MeV are calculated within the framework of the random phase approximation (RPA). The residual particle-hole interaction is assumed to be a separate multiple force, the parameters of which are obtained by fitting observed levels in ^{208}Pb. The calculated angular distributions reproduce the general trends of the experimental results except for a more pronounced oscillatory behavior. The excitation functions are in semi-quantitative agreement with experiment only for the $\frac{5}{2}^-$ and $\frac{3}{2}^-$ final target states. The results demonstrate the need to determine the effective interaction in the space of states in which it is to be used. Cross sections calculated with an interaction determined by including bound-state configurations only are in worse agreement consistently with experiment than those calculated with a "continuum-renormalized" interaction. The ground-state correlations introduced by the RPA are found to be most important for low incident neutron energies ($\lesssim$4 MeV). For higher energies, the RPA and Tamm–Dandoff cross sections are very similar. The relation between this treatment and the Hauser–Feshbach theory is discussed. (auth)

52165 RPA CALCULATIONS IN THE CONTINUUM. II. BOUND STATES AND RESONANCE ENERGIES IN ^{208}Pb. Dover, Carl B.; Hahne, F. J. W. (Univ., Heidelberg). Nucl. Phys., A135: 515-34(1969).

The energies and widths of particle-hole states in ^{208}Pb are calculated within the framework of the random phase approximation (RPA) including the coupling to the continuum. Low-lying collective states are found to experience a considerable energy shift due to the presence of the continuum, while relatively pure particle-hole configurations are less affected. Trajectories of bound states embedded in the continuum and single-particle resonances in the complex energy plane are plotted as a function of the strength of the continuum coupling. The validity of certain sum rules relating widths is examined numerically. (auth)

52166 THE DECAY SCHEME OF THE SEPTUPLET IN THE NUCLEUS ^{209}Bi. Hamamoto, Ikuko (Univ. of Copenhagen). Nucl. Phys., A135: 576-90(1969).

The decay scheme of the septuplet (particle-vibration states) in the nucleus ^{209}Bi is investigated by solving the inhomogeneous differential equations obtained from the Schroedinger equation. The calculation takes into account the contribution from all the graphs in the lowest order of particle-vibration coupling Hamiltonian to each electromagnetic transition. (auth)

52167 STRUCTURE OF GENERALIZED NEUTRON PARTICLE-HOLE STATES IN ^{140}Ce. Heusler, A.; Harney, H. L.; Wurm, J. P. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Nucl. Phys., A135: 591-608(1969).

Inelastic proton scattering on ^{140}Ce via the $\frac{7}{2}^-$ g.s. isobaric analogue resonance in ^{141}Pr is analyzed. The states at E_x = 3.402, 3.478, 3.710, 3.792, 3.912, 4.000 and 4.538 MeV in ^{140}Ce are interpreted as generalized neutron particle-hole (GNPH) states with the spins $J^\pi = 4^-, 3^-, 5^-, 3^-, 2^-, 4^-$, and 3^-, respectively. Their wave functions are determined in terms of GNPH configurations. In the seven states, the strengths of the GNPH configurations $|s_{\frac{1}{2}}^{-1} \otimes {}^{141}\text{Ce}\ (\text{g.s.}, \frac{7}{2}^-)\rangle$ and $|d_{\frac{3}{2}}^{-1} \otimes {}^{141}\text{Ce}\ (\text{g.s.}, \frac{7}{2}^-)\rangle$ are found almost completely. Their centers of gravity are determined. (auth)

Nuclear Theory

Refer also to abstracts 51383, 51857, 51892, 51950, 51953, 51967, 51969, 51970, 51973, 52015, 52016, 52027, 52118, 52119, 52132, and 52451.

52168 (COO-1265-59) NUCLEON-NUCLEUS OPTICAL MODEL PARAMETERS, A > 40, E < 50 MeV. Becchetti, F. D. Jr.; Greenlees, G. W. (Minnesota Univ., Minneapolis. School of Physics). [1967]. 50p. Dep. CFSTI.

Proton-nucleus and neutron-nucleus standard optical model parameters are given that represent, quite well, much of the elastic scattering data in the range A > 40, E < 50 MeV. These parameters were determined by fitting simultaneously a large sample of the available proton data, and independently, a large sample of the available neutron data. Explicit energy and isospin dependent terms were included and their coefficients obtained directly from the data analysis. The results are shown

to be consistent with the range and strength of the central and isospin components of the two body interaction. (auth)

52169 (JINR-E4-4601) RESONANCE MECHANISM OF MUON CAPTURE BY COMPLEX NUCLEI. Balashov, V. V.; Eramzhyan, R. A.; Kabachnik, N. M.; Korenman, G. Ya; Korotkikh, V. L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1969. 25p. (CONF-690914-2). Dep. CFSTI (U. S. Sales Only).

From 3rd International Conference on High Energy Physics and Nuclear Structure, New York.

The physics of μ-capture: the asymmetry of the neutron angular distribution, the structure of the neutron energy spectra and the mechanism of charged particle emission, is discussed within the resonance model. The idea of the resonance mechanism in muon capture gives a general basis for further investigation (in the energy range corresponding to a giant resonance) of the process accompanying μ-capture. (auth)

52170 (JINR-E4-4686) SPIN-ORBIT INTERACTION IN THE DEUTERON STRIPPING REACTION ON DEFORMED NUCLEI. Schulz, H.; Wiebicke, H. J. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1969. 10p. Dep. CFSTI (U. S. Sales Only).

In terms of the DWBA the deuteron stripping reaction on deformed nuclei is considered. The Schroedinger equation for the distorted waves is solved by means of the coupled channels procedure. The optical potential includes a spherical spin-orbit coupling part. Exact expressions for the differential cross section and the polarization are obtained. (auth)

52171 (JPRS-48331, pp 74-81) WHAT MODERN THEORY CAN OFFER FOR CALCULATIONS OF CROSS SECTIONS OF THE INTERACTION OF NEUTRONS WITH NUCLEI. Stavinskii, V. S. Translated from pp 69-74 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 2, Obninsk, 1967.

The theoretical models used in studying the interactions of neutrons with nuclei which are of interest in neutron transport theory are discussed. A brief outline is presented of recent achievements in low-energy nuclear physics which are directly connected with the development of methods for calculating neutron cross sections. (J.W.R.)

52172 (UCRL-18667, pp 133-67) NUCLEAR THEORY. (California Univ., Berkeley. Lawrence Radiation Lab.).

BORON-10—triton reactions (t,p) with, DWBA analysis of
CADMIUM-114—energy levels of, calculation using boson method (T)
ERBIUM-166—alpha inelastic scattering at 50 MeV, angular distributions for (T)
FISSION—probability in nuclear reactions, shell and pairing effects on (T)
MAGNESIUM-24—proton inelastic scattering using polarized beams, coupled-channel analysis of (T)
NEON-20—energy levels of, calculation using Hartree-Fock method and Tamm-Dancoff approximation (T)
NICKEL-62—proton reactions (p,t) with, inelastic processes in (T)
NUCLEAR MODELS—pairing-plus-quadrupole derivation of quadrupole force from Woods-Saxon potential (T)
NUCLEAR REACTIONS—theory of (p,t) transfer, role of inelastic processes in
—fission probability in, shell and pairing affects on (T)
NUCLEAR STRUCTURE—neutron pairing states in even-even nuclei (T)
NUCLEI—neutron pairing states in even-even (T)
SAMARIUM-148—energy levels of, calculation using boson method (T)
SAMARIUM-150—energy levels of, calculation using boson method (T)
SAMARIUM-152—alpha inelastic scattering at 50 MeV, angular distributions for (T)
—energy levels of, calculation using boson method (T)
TELLURIUM-122—energy levels of, calculation using boson method (T)
TIN-116—energy levels of, calculation using boson method (T)
TIN-120—energy levels of, calculation using boson method (T)
ZIRCONIUM-90—proton inelastic scattering using polarized beams, coupled-channel analysis of (T)
ZIRCONIUM-92—proton inelastic scattering using polarized beams, coupled-channel analysis of (T) (L.T.W.)

52173 (UCRL-18899) ON THE MICROSCOPIC AND MACROSCOPIC ASPECTS OF NUCLEAR STRUCTURE WITH APPLICATIONS TO SUPERHEAVY NUCLEI. Tsang, Chin-Fu (California Univ., Berkeley. Lawrence Radiation Lab.). May 22, 1969. Contract W-7405-eng-48. 209p. Dep. CFSTI.

Thesis.

The relation between a microscopic approach and a macroscopic approach to the study of the nuclear binding energy as a function of neutron number, proton number and nuclear deformations, is studied. A general discussion is given of the potential energy of a system which can be divided into a bulk region and a thin skin layer. This energy can be written down in the usual liquid drop type of expression, i.e., in terms of the volume, the surface area and other macroscopic properties of the system. The discussion is illustrated by a study of noninteracting particles in an orthorhombic potential well with zero potential inside and infinite potential outside. The total energy is calculated both exactly (a microscopic approach) and also from a liquid drop type of expression (a macroscopic approach). The saddle point shapes of a charged conducting drop on a pure liquid drop model are examined. The properties of a conducting drop are compared with those of a drop whose charges are distributed uniformly throughout its volume. The Strutinski method is to synthesize a microscopic approach (the Nilsson model) and a macroscopic approach (the Liquid drop model). The results are applied to realistic nuclei. The possible occurrence of shape isomers comes as a natural consequence of the calculation. Their trends as a function of neutron and proton members are discussed and the results are tabulated. The stabilities of the predicted superheavy nuclei with proton number around 114 and neutron number around 184 and 196 are worked out. Some of these nuclei appear to have extremely long life times. The possible experimental production of these superheavy nuclei are also discussed. (auth)

52174 NUCLEAR ELECTRODISINTEGRATION WITH NUCLEON EMISSION. Strachan, C.; Watt, A. (Univ. of Aberdeen, Scotland). J. Phys., A (London), 2: 547-58(Sept. 1969).

The emission of single nucleons by the scattering of electrons from nuclei is investigated. Center-of-mass and relative coordinates are used, since this avoids the Gartenhaus-Schwartz transformation and associated difficulties. The Hamiltonian describing the interaction between the electron and the nucleons is expanded in multipoles, and it is found possible to perform several of the summations over final-state angular momentum quantum numbers. The resulting formulas are applied to the electrodisintegration of ^{12}C, and comparison is made with experiment. It is of interest that, as regards the position of the maximum in the cross section, agreement with experiment is improved by introduction of a final-state interaction, which is taken to be real and central. The magnitude of the cross section is, however, about twice as large as the experimental value, even allowing for uncertainties in the experimental result. (auth) (UK)

52175 SIMPLE MODEL OF THE TRITON. Coffou, E. (Inst. Rudjer Boskovic, Zagreb). Z. Phys., 228: 163-71(1969).

A model of triton was considered in which three interactions between nucleons were approximated by harmonic oscillator forces of different strengths. The parameters were determined by fitting the mass radius, the charge radius and the binding energy of the triton. The model involves an exact solution of the three-body problem. The wave function parameters and various physical parameters of the triton were calculated. The assessment of the neutron-neutron interaction was obtained irrespectively of the charge independence of nuclear forces. The model provides the possibility of testing the fulfilment of charge independence using the neutron-proton interaction only. (auth)

52176 RADIOACTIVE DISINTEGRATION OF ^{186}Ta. Monnand, E.; Blachot, J.; Moussa, A. (CEN, Grenoble, France). Nucl. Phys., A134: 321-35(1969). (In French).

The decay of ^{186}Ta leading to ^{186}W excited states was studied with Ge(Li) detectors for the γ-ray spectra and with anthracene and plastic detectors for the β-ray spectra. Three β-groups of maximum energies about 1740, 2240, and 2620 keV and 42 γ-rays are observed. The $\beta-\gamma$ and $\gamma-\gamma$ coincidence measurements are carried out whenever this is possible. A level scheme with 14 excited states is proposed for ^{186}W. (auth)

52177 NUCLEON AND CLUSTER EMISSION IN ELECTRON SCATTERING. Watt, A. (Univ. of Aberdeen, Scotland). J. Phys., A (London), 2: 559-73(Sept. 1969).

The electrodisintegration of nuclei into two fragments is investigated, and formulas are derived for the cross section. It is assumed that the nucleus in its initial state is made up of the two clusters interacting with each other to form a bound state. The theory is applied to the problem of single-nucleon emission in order to investigate the importance of indirect processes in the quasi-elastic peak. These are found to reduce the cross section by a few per cent, which is not enough to give agreement with experiment. (auth) (UK)

52178 ENERGY VARIATION OF THE EFFECTIVE HAMILTONIAN. Flores, J.; Fortes, M.; Mello, P. A. (Univ. Nacional Autonoma de Mexico, Mexico City). Rev. Mex. Fis., 18: 173-94 (1969).

Some general properties of the eigenvalues of the effective Hamiltonian, defined in a finite space, are discussed. In particular, it is shown that neglecting self-consistency in the calculation of the effective Hamiltonian may lead to wrong conclusions. These properties are shown explicitly in a numerical example. (auth)

52179 DISTORTED WAVE THEORY OF THE 50 MeV (p,2p) REACTION. McCarthy, I. E.; Thomas, A. W. (Flinders Univ. of South Australia, Bedford Park). Nucl. Phys., A135: 463-71 (1969).

An attempt is made to answer the question whether distorting potentials that give really good fits to elastic scattering cross sections and total reaction cross sections for experiments in the relevant two-body subsystems can correctly give positions of maxima and minima in the (p,2p) angular correlation. The 50 MeV energy range is chosen because the angular correlation is very sensitive to the distortion. It is found that the positions are correctly reproduced by good elastic scattering parameters for the reaction $^{89}Y(p,2p)^{88}Sr$, Q = 7.44 MeV, at 46 MeV. The shortcoming of the distorted wave theory at this energy, as at higher energies, is that the calculated ratio of the cross section at small angles to that at large angles is too large. Apart from this serious defect, the shape of the angular correlation for $^{12}C(p,2p)^{11}B$, Q = 16 MeV, at 50 MeV is also encouraging. Previous studies suggest that the defect can be corrected if a better description of the p-p t-matrix is used in the distorted wave theory. (auth)

52180 COULOMB DISPLACEMENT ENERGIES AND NUCLEAR SIZES. Friedman, E.; Mandelbaum, B. (Hebrew Univ., Jerusalem). Nucl. Phys., A135: 472-80(1969).

The Coulomb displacement energy between isobaric analog states is calculated as a function of the rms radius of the distribution of the excess neutrons for a known value of the rms radius of the charge distribution in the neutron analog. The exchange term, the Coulomb spin-orbit term and the Thomas–Ehrman shift are included and effects of configuration mixing are studied. It is concluded that if the rms radius of the charge distribution and the Coulomb displacement energies are known, the rms radius of the excess neutrons can be extracted to an accuracy of better than ±0.1 fm. (auth)

52181 EFFECTIVE NUCLEON–NUCLEON INTERACTION FOR VARIATIONAL CALCULATIONS. Pandharipande, V. R. (Tata Inst. of Fundamental Research, Bombay). Nucl. Phys., A135: 419-31(1969).

The parameters of density-dependent effective interaction suggested by Bethe are determined from restricted Hartree–Fock calculations in ^{4}He, ^{16}O, ^{40}Ca and infinite nuclear matter. The parameters of an equivalent momentum-dependent interaction are also studied. It is shown that the contributions of the proposed density-dependent interaction to the binding energy of nuclear matter closely resemble those of the Reid potential. The distribution of neutron and proton densities in ^{40}Ca, ^{120}Sn and ^{208}Pb is studied with this interaction by a variational method using local density approximation. The calculated binding energies, radii, central densities and surface thickness are in good agreement with the experimental data. (auth)

52182 A METHOD FOR SOLVING THE INDEPENDENT-PARTICLE SCHROEDINGER EQUATION WITH A DEFORMED AVERAGE FIELD. Damgaard, J.; Pauli, H. C.; Pashkevich, V. V.; Strutinsky, V. M. (Univ. of Copenhagen). Nucl. Phys., A135: 432-44(1969).

A method suited for numerical computation is proposed for solving the nuclear independent-particle problem for axially symmetric nuclei. (auth)

52183 CHARGE DISTRIBUTION OF EXCITED STATES OF ODD-MASS NUCLEI. Speth, J. (Technische Hochschule, Munich). Nucl. Phys., A135: 445-62(1969).

From a very general formulation of the theory of interacting Fermi systems with pair correlations, the special case of the Migdal–Larkin theory for finite systems is derived, and the approximations of this theory are discussed. In a rigorous way not based on perturbation theory, the change of the density matrix due to the addition of another particle is derived for a Fermi system with pair correlations. The inhomogeneous term of this equation is identical with the result of the BCS theory in contrast to Migdal's equation. For some odd-mass nuclei in the rare-earth region, the change of the rms charge radius connected with the transition from the ground state to an excited state is calculated with this equation. The theoretical results are in good agreement with experiment. (auth)

52184 INVERSE SCATTERING PROBLEM FOR RANK-TWO SEPARABLE POTENTIALS AND OFF-SHELL EFFECTS. Fiedeldey, H. (Atomic Energy Board, Pelindaba, South Africa). Nucl. Phys., A135: 353-77(1969).

An exact solution is given for the inverse scattering problem for rank-two separable potentials. It is shown that one of the form factors can be chosen arbitrarily, in practice the attractive one. If we require that the potential in addition to phase shift and binding energy also reproduces an arbitrary bound state wave function, a special and unique solution is obtained. This special potential is shown to be promising as a first order approximation to a local potential. The arbitrariness of the attractive form factor is used to investigate off-shell effects in the simplest and most direct way, by calculating the half-off-shell R-matrix. By only changing the strength and the range of an attractive form factor of the Yamaguchi type, we already obtain large differences in the half-off-shell R-matrix. On the other hand it is found that two rank-two separable potentials having the same bound state wave function in addition to the same phase shift and binding energy also have nearly the same half-off-shell R-matrix, in spite of their having rather different form factors. (auth)

52185 REACTIONS WITH TRANSFER OF k-NUCLEONS AND NUCLEAR STRUCTURE. Rotter, Ingrid (Joint Inst. for Nuclear Research, Moscow). Nucl. Phys., A135: 378-94(1969).

Assuming a pure transfer mechanism, the structure factor determining the excitation of the final nucleus in reactions of the type $A + B \rightarrow (A - k) + (B + k)$ with k = 2, 3, 4 is discussed in some detail. All intermediate states of the group of transferred particles are taken into account. The structure factor is written in a form analogous to that of the structure factor of reactions with one-nucleon transfer. The theory determining the dynamical factor of reactions with one-nucleon transfer can therefore be applied also to reactions with the transfer of a group of nucleons. It is shown that there is no factorization of the spectroscopic factor of the reaction into two factors one of which depends only on the properties of the nuclei A and A – k and the other depends only on the properties of the nuclei B and B + k. The excitation spectra of the final nucleus observed in different reactions with the transfer of k nucleons on the same target nucleus will be different from one another, as a rule, and are not directly determined by the usual spectroscopic factors for the corresponding nucleon group. Exceptions to this rule are discussed. (auth)

52186 RETARDED INTERACTIONS IN FERMI SYSTEMS. II. QUASIPARTICLE LIFETIMES. Dover, C. B.; Lemmer, R. H. (South African Atomic Energy Board, Pretoria). Phys. Rev., 183: 908-18(July 20, 1969).

Properties of the inverse lifetime $1/\tau$ of quasiparticles in an infinite system of nucleons ("nuclear matter") interacting via the exchange of a neutral scalar boson are studied in the dielectric formulation of the many-body problem. It is shown that the polarization of the nuclear medium plays an essential role in determining $1/\tau$. The presence of the medium mediates the interaction between two nucleons in it through the introduction of an effective "dielectric constant" for nuclear matter. The interaction becomes "dressed" in a fashion analogous to, but different in its details from, the screening of the Coulomb interaction between electrons in metals. Calculations of $1/\tau$ are made for nuclear matter both in second-order perturbation theory, and using the fully dressed interaction calculated in the random-phase approximation (RPA). The RPA estimate is lower by about a factor of 3 over a wide range of momenta and is in good agreement with empirical optical-model estimates of $1/\tau$. The second-order perturbation estimate is by contrast entirely inadequate, emphasizing the importance of taking the polarization effects into account for scattering processes at actual nuclear densities. The use of a dielectric constant for the medium also introduces another feature into the properties of $1/\tau$. The behavior of $1/\tau$ near the Fermi surface now becomes sensitive to whether or not the interacting ground state is unstable with respect to a permanent density fluctuation. If it is, then $1/\tau$ behaves like $(p - p_F)$ instead of $(p - p_F)^2$ near the Fermi surface (p_F is the Fermi momentum). This is not a new physical result, but rather a reflection of the inadequacy of the RPA if the system becomes unstable. It is shown that as the momentum increases the effect of such an instability, if present, decreases, and becomes entirely negligible when $p \gtrsim \sqrt{2}p_F$. (auth)

52187 SINGLE-PARTICLE THEORY OF FISSION. Brandt, A. (Weizmann Inst., Rehovot, Israel); Kelson, I. Contract AT(30-1)-3223. Phys. Rev., 183: 1025-54(July 20, 1969).

The single-particle aspects of nuclear fission theories are investigated. The liquid drop model is shown to be essentially equivalent to an independent particle model with the requirement that particles occupy the lowest orbits. The consequences of relaxing this requirement are pursued and are shown to be significant. A natural framework is provided in which the mass asym-

metry of fission arises naturally. A report is given of the technical aspects and the quantitative results of a detailed model calculation. Some of the indicated conclusions are formulated as phenomenological rules. (auth)

52188 NUCLEAR SPECTROSCOPY ON DEFORMED NUCLEI WITH TWO-NEUTRON TRANSFER REACTIONS. Broglia, R. A. (Univ. of Minnesota, Minneapolis); Riedel, C.; Udagawa, T. Nucl. Phys., A135: 561-75(1969).

The formalism for calculating (t,p) and (p,t) reactions on quadrupole deformed nuclei is presented. It is applied to the calculation of the cross sections associated with the excitations of members of the ground state rotational band of nuclei in the rare-earth region. Comparison with the available experimental material is carried out. Special attention is paid to the relation between multipole pairing moments and reaction cross sections. The possibility of determining deformation parameters is pointed out. (auth)

REACTOR TECHNOLOGY

Commercial Power Reactors

Refer also to abstracts 49897, 50978, 51040, and 52491.

52189 (APDA–309) PRIMARY SODIUM SYSTEM PUMPS IN THE ENRICO FERMI ATOMIC POWER PLANT. Ross, T. P. (Atomic Power Development Associates, Inc., Detroit, Mich.). June 1969. Contract AT(11-1)-865. 363p. Dep. CFSTI.

The development of the primary sodium system pumps at the Enrico Fermi Atomic Power Plant is described from the concept stage through design, fabrication, testing, and operation in a nuclear plant. The influence of a developing design of a fast breeder reactor on the selection of a primary pump is discussed. Fabrication, erection, and water tests at the vendor's plant are also presented. Experience in preliminary and preoperational testing is presented in detail, including an evaluation of the mechanical and hydraulic performance of the pump under normal and abnormal operating conditions. A detailed description of the pump, pump drives, and pump auxiliaries is included. The performance of the pump auxiliaries and their effect on pump operation are also presented. The operating and maintenance histories of the pump and auxiliaries are documented. Conclusions and recommendations for the design of future sodium pumps, based on experience with the primary sodium pumps, are summarized. (15 references) (auth)

52190 (APDA-CFE–29) COMPILATION OF CURRENT TECHNICAL EXPERIENCE AT ENRICO FERMI ATOMIC POWER PLANT, JANUARY 1969. Mueller, R. E. (Atomic Power Development Associates, Inc., Detroit, Mich. Power Reactor Development Co., Detroit, Mich. Detroit Edison Co., Mich.). June 1969. Contract AT(11-1)-865. 42p. Dep. CFSTI.

Work Performed under United States–Euratom Fast Reactor Exchange Program.

The welding of the remaining zirconium screw shanks in the lower plenum of the Fermi Fast Breeder is described. The clearing and radioactivity measurements of the recovered zirconium flow-guide segments is described. The vacuuming of the lower plenum area is discussed; the improvised vacuum cleaner is described. The status of the primary sodium and cover gas systems is summarized. Neutron detector tube cooling modifications are described. Fuel and repair building maintenance work is summarized. (M.L.S.)

52191 (APED–5449) CONTROL ROD WORTH MINIMIZER. Stanley, L.; Starr, J. D.; Thompson, O. A. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Mar. 1967. 38p. Dep. CFSTI.

A functional description of the rod-worth minimizer for the boiling water power reactor is given. System components are described; a block diagram of the system is shown. System operation is detailed. The interlock network is illustrated by a schematic. The computer program and operation is discussed; a program flow chart is included. A summary of rod-worth-minimizer corrective actions is tabulated. (M.L.S.)

52192 (DOCKET-50003–10) INDIAN POINT UNIT NO. 1. Earthquake and Tornado Analyses of Structures. (Blume (John A.) and Associates, Engineers, San Francisco, Calif.). Sept. 5, 1969. 92p. Dep. CFSTI.

For Consolidated Edison Co. of New York, Inc., New York.

Seismic and tornado analyses for plant facilities and buildings are presented. (D.C.C.)

52193 (DOCKET-50003–11) INDIAN POINT UNIT NO. 1. Earthquake Analysis of Piping Systems. (Blume (John A.) and Associates, Engineers, San Francisco, Calif.). Sept. 12, 1969. 165p. Dep. CFSTI.

For Consolidated Edison Co. of New York, Inc., New York.

Seismic analysis of Class 1 piping systems is presented. Piping systems described include: decay heat cooling system; boiler feed system; primary relief system; pressurizer system; main steam line system; primary coolant system; and containment external spray system. (D.C.C.)

52194 (DOCKET-50003–12) INDIAN POINT UNIT NO. 1. Analysis of Core B Performance at 96.0 Percent Rated Power with Three Loops and Five Primary Coolant Pumps Operating. (Consolidated Edison Co. of New York, Inc., New York). Sept. 29, 1969. 32p. Dep. CFSTI.

Nominal conditions for operation of the 3 loop primary cooling system with 5 and 6 pumps are presented. Thermal and hydraulic characteristics are listed. Response under coolant loss conditions is analyzed. 9 references. (D.C.C.)

52195 (DOCKET-50016–27) ENRICO FERMI ATOMIC POWER PLANT. License No. DPR-9: Technical Specifications, Change No. 18. (Power Reactor Development Co., Detroit, Mich.). Oct. 16, 1969. 8p. Dep. CFSTI.

Changes in Technical Specifications for the Fermi Fast Breeder Reactor are discussed. Maximum flow rates are revised upward to 5.3×10^6 lb/hr to permit demonstration of the engineering performance of the system. Analyses of this flow increase are detailed. Coolant piping vibration is shown as a function of flowrate. (M.L.S.)

52196 (DOCKET-50029–102) YANKEE NUCLEAR POWER STATION. Operation Report No. 105, September 1969. (Yankee Atomic Electric Co., Boston, Mass.). Oct. 22, 1969. 10p. Dep. CFSTI.

52197 (DOCKET-50213–19) CONNECTICUT YANKEE ATOMIC POWER PLANT. Operation Report, September 1969. (Connecticut Yankee Atomic Power Co., Boston, Mass.). Oct. 13, 1969. 14p. (NYO–3250-40). Dep. CFSTI.

52198 (DOCKET-50219–26) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. [Preliminary Safety Analysis Report], Amendment 23. (Jersey Central Power and Light Co., Morristown, N. J.). Oct. 31, 1967. 83p. Dep. CFSTI.

Safety limits on emergency systems are described. Surveillance requirements for reactor systems and emergency systems are discussed. (D.C.C.)

52199 (DOCKET-50219–27) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. Application for Reactor Construction Permit and Operating License, Pt. A. (Jersey Central Power and Light Co., Morristown, N. J.). May 12, 1964. 12p. Dep. CFSTI.

Information is presented for a construction permit and an operating license. The nuclear power experience of Burns and Roe, Incorporated, is reviewed. (D.C.C.)

52200 (DOCKET-50219–28) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. [Preliminary Safety Analysis Report], Amendment 6. (Jersey Central Power and Light Co., Morristown, N. J.). July 26, 1967. 34p. Dep. CFSTI.

Financial data on the owners of the Oyster Creek Power Reactor Unit 1 are given in support of the application for operating license. The 1966 Annual Report for the Jersey Central Power and Light Company and the 1966 Annual Report for the General Public Utilities Corporation are presented. A schedule of estimated expenditures for the plant is given. (D.C.C.)

52201 (DOCKET-50219–29) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. [Preliminary Safety Analysis Report], Amendment 7. (Jersey Central Power and Light Co., Morristown, N. J.). Aug. 28, 1967. 13p. Dep. CFSTI.

Core thermal and hydraulic design parameter revisions are presented. Revised information is also presented for containment systems, control rod drives, and emergency systems. (D.C.C.)

52202 (DOCKET-50219–30) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. [Preliminary Safety Analysis Report], Amendment 8. (Jersey Central Power and Light Co., Morristown, N. J.). Aug. 28, 1967. 61p. Dep. CFSTI.

The effects of level swell, steam cooling and fission gas distribution on the predictions of peak clad temperature and percent of rods perforated for small break loss of coolant accidents are analyzed. Thermal analysis for a small break accident is presented. Emergency core cooling spray system requirements are described. Emergency systems operation sequences are analyzed. (D.C.C.)

52203 (DOCKET-50219–31) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. Core Thermal and Hydraulic Uncertainty Analysis. [Preliminary Safety Analysis Report], Amendment 9. (Jersey Central Power and Light Co., Morristown, N. J.). Sept. 5, 1967. 9p. Dep. CFSTI.

Probable fuel element failure rates are calculated. (D.C.C.)

52204 (DOCKET-50219–32) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. Emergency Core Cooling Effectiveness. [Preliminary Safety Analysis Report], Amendment 10. (Jersey Central Power and Light Co., Morristown, N. J.). Sept. 5, 1967. 90p. Dep. CFSTI.

The performance characteristics of the emergency core cooling spray system are described. Illustrations and test data are presented. (D.C.C.)

52205 (DOCKET-50219-33) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. Reactor Vessel Internals Integrity Analysis. [Preliminary Safety Analysis Report], Amendment 12. (Jersey Central Power and Light Co., Morristown, N. J.). Sept. 5, 1967. 15p. Dep. CFSTI.

Stress analysis for core structure components is presented. Failure stresses due to reactor conditions and seismic conditions are described. (D.C.C.)

52206 (DOCKET-50219-34) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. Site Meteorological-Radiological Evaluation. (Jersey Central Power and Light Co., Morristown, N. J.). Sept. 22, 1967. 101p. Dep. CFSTI.

Meteorological data for the reactor site during February 1966 to February 1967 are analyzed. Radiological data are presented for 1963. (D.C.C.)

52207 (DOCKET-50219-35) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. Primary Containment Design Report. (Jersey Central Power and Light Co., Morristown, N. J.). Sept. 11, 1967. 343p. Dep. CFSTI.

Design basis, design evaluation, fabrication methods, inspection, and testing procedures for the primary containment structures of Oyster Creek Power Reactor Unit 1 are presented. (D.C.C.)

52208 (DOCKET-50219-36) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. Reactor Pressure Vessel Design Report. [Preliminary Safety Analysis Report], Amendment 16. (Jersey Central Power and Light Co., Morristown, N. J.). Sept. 22, 1967. 213p. Dep. CFSTI.

Design basis, design parameters, inspection, and testing procedures for the pressure vessel of Oyster Creek Power Reactor Unit 1 are presented. (D.C.C.)

52209 (DOCKET-50219-37) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. [Preliminary Safety Analysis Report], Amendment 18. (Jersey Central Power and Light Co., Morristown, N. J.). Oct. 16, 1967. 18p. Dep. CFSTI.

The emergency use of control rod drive pumps to maintain the core water level under slow leak rate conditions is analyzed. Design parameters of the emergency core cooling spray system are presented. Isolation systems are described for corner rooms of the reactor building. Emergency power system fuel supply is analyzed. (D.C.C.)

52210 (DOCKET-50219-38) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. [Preliminary Safety Analysis Report], Amendment 26. (Jersey Central Power and Light Co., Morristown, N. J.). Nov. 30, 1967. 4p. Dep. CFSTI.

Proposed radiological monitoring programs for the reactor site are described. (D.C.C.)

52211 (DOCKET-50219-39) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. Plant Quality Assurance Report. [Preliminary Safety Analysis Report], Amendment 27. (Jersey Central Power and Light Co., Morristown, N. J.). Dec. 5, 1967. 36p. Dep. CFSTI.

Quality control procedures and requirements for reactor component fabrication and shipping are described. Testing programs for installed systems are reviewed. (D.C.C.)

52212 (DOCKET-50219-40) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. [Preliminary Safety Analysis Report], Amendment 28. (Jersey Central Power and Light Co., Morristown, N. J.). Dec. 5, 1967. 56p. Dep. CFSTI.

The emergency core cooling system is described. Seismic stress conditions for the 20 in. suction header of the pressure suppression system are analyzed. The scram shutdown system trip points are described. The performance of main steam line isolation valves is reviewed. Missile hazards and water loss conditions for spent fuel storage pool are described. (D.C.C.)

52213 (DOCKET-50219-41) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. Core Spray System Evaluation. [Preliminary Safety Analysis Report], Amendment 30. (Jersey Central Power and Light Co., Morristown, N. J.). Dec. 5, 1967. 8p. Dep. CFSTI.

Performance testing is described for the modified emergency core spray system. (D.C.C.)

52214 (DOCKET-50219-42) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. [Preliminary Safety Analysis Report], Amendment 31. (Jersey Central Power and Light Co., Morristown, N. J.). Dec. 19, 1967. 47p. Dep. CFSTI.

Revised information is presented for the site of Oyster Creek Power Reactor Unit 1. Design parameters for the cooling system are included. Seismic stress conditions for reactor components and buildings are analyzed. Effects of accident conditions on fission product release are described. Core heat transfer is analyzed. (D.C.C.)

52215 (DOCKET-50219-43) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. [Preliminary Safety Analysis Report], Amendment 32. (Jersey Central Power and Light Co., Morristown, N. J.). Feb. 20, 1968. 37p. Dep. CFSTI.

Emergency power system loadings are described. Quality control procedures in the manufacture of emergency isolation valves are listed. Leak rate testing of containment systems under prepurge conditions is described. Support structures for the pressure suppression chamber 20 in. suction header are illustrated and described. Missile hazards from a tornado, failure of facility stack, or turbine failure are analyzed for the fuel storage pool. Leak detection system modifications for the drywell are described. Scram circuits are illustrated. The mechanical vacuum pump and isolation valve systems are illustrated. (D.C.C.)

52216 (DOCKET-50219-44) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. Main Steam Isolation Valve; Analysis of Operating Conditions and Assurance of Operability. [Preliminary Safety Analysis Report], Amendment 33. (Jersey Central Power and Light Co., Morristown, N. J.). Jan. 9, 1968. 79p. Dep. CFSTI.

Performance of main steam isolation valves are tested under blowdown accident conditions. Diagrams of the test apparatus and of the isolation valves are presented. Test data are included. (D.C.C.)

52217 (DOCKET-50219-45) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. [Preliminary Safety Analysis Report], Amendment 34. (Jersey Central Power and Light Co., Morristown, N. J.). Mar. 22, 1968. 84p. Dep. CFSTI.

The emergency core cooling system is described. Emergency power supply operation sequence is presented. Performance testing of the main steam line isolation valve is reviewed. Possibilities of pipe breaks in feedwater, drain, recirculation, and steam lines are analyzed. (D.C.C.)

52218 (DOCKET-50219-46) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. [Preliminary Safety Analysis Report], Amendment 38. (Jersey Central Power and Light Co., Morristown, N. J.). July 8, 1968. 42p. Dep. CFSTI.

The emergency core cooling system is described. Initiating sequences for the emergency cooling system and power system are presented. Seismic stress requirements for reactor cooling system facilities are described. (D.C.C.)

52219 (DOCKET-50219-47) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. [Preliminary Safety Analysis Report], Amendment 39. (Jersey Central Power and Light Co., Morristown, N. J.). July 8, 1968. 63p. Dep. CFSTI.

Quality control procedures and requirements for reactor field fabrication are described. Testing programs for field fabrication are presented. (D.C.C.)

52220 (DOCKET-50219-48) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. [Preliminary Safety Analysis Report], Amendment 42. (Jersey Central Power and Light Co., Morristown, N. J.). Oct. 29, 1968. 6p. Dep. CFSTI.

The emergency cooling system for the reactor building corner rooms is described. (D.C.C.)

52221 (DOCKET-50219-49) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. Proposed Technical Specification. [Preliminary Safety Analysis Report], Amendment 44. (Jersey Central Power and Light Co., Morristown, N. J.). Nov. 1, 1968. 130p. Dep. CFSTI.

Safety limits for emergency system initiation are described. Protective instrumentation requirements are listed. Control rod scram sequence is analyzed. Emergency core cooling system, containment, and emergency power systems are described, and their response during accident conditions are analyzed. Requirements for radiation monitoring systems are discussed. Personnel responsibilities and qualifications are itemized. (D.C.C.)

52222 (DOCKET-50219-50) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. [Preliminary Safety Analysis Report], Amendment 45. (Jersey Central Power and Light Co., Morristown, N. J.). Nov. 18, 1968. 33p. Dep. CFSTI.

Radiation dose distribution diagrams for normal reactor operation are presented. Transient responses are plotted for emergency systems under accident conditions. (D.C.C.)

52223 (DOCKET-50219-51) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. [Preliminary Safety Analysis Report], Amendment 46. (Jersey Central Power and Light Co., Morristown, N. J.). Oct. 9, 1968. 3p. Dep. CFSTI.

Personnel involved with the startup and power operation test program are listed. (D.C.C.)

52224 (DOCKET-50219-52) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. [Preliminary Safety Analysis Report], Amendment 48. (Jersey Central Power and Light Co., Morristown, N. J.). Nov. 20, 1968. 11p. Dep. CFSTI.

Tensile stress test results for pressure vessel steel specimens are presented. Cooling system vibration test results are described. (D.C.C.)

52225 (DOCKET-50219-53) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. 1967 Report to Stockholders: General Public Utilities. [Preliminary Safety Analysis Report], Amendment 49. (Jersey Central Power and Light Co., Morristown, N. J.). Feb. 16, 1968. 36p. Dep. CFSTI.

Financial data on the owners of the Oyster Creek Power Reactor Unit 1 are given. The 1967 Annual Report for the General Public Utilities Corporation is included. (D.C.C.)

52226 (DOCKET-50219-54) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. Primary Containment Penetration Design. [Preliminary Safety Analysis Report], Amendment 50. (Jersey Central Power and Light Co., Morristown, N. J.). Mar. 3, 1969. 9p. Dep. CFSTI.

Design requirements and parameters for drywell containment structure penetrations are presented. (D.C.C.)

52227 (DOCKET-50219-55) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. [Preliminary Safety Analysis Report], Amendment 51. (Jersey Central Power and Light Co., Morristown, N. J.). Mar. 25, 1969. 30p. Dep. CFSTI.

Stress analysis for drywell containment structure penetrations is presented. Hydraulic stresses due to pipe failure are analyzed. (D.C.C.)

52228 (DOCKET-50219-56) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. [Preliminary Safety Analysis Report], Amendment 52. (Jersey Central Power and Light Co., Morristown, N. J.). Mar. 28, 1969. 48p. Dep. CFSTI.

Startup procedures are reviewed. Qualifications of startup personnel are listed. Testing programs are described. Qualifications of test program personnel are listed. Containment leakage test results are included. (D.C.C.)

52229 (DOCKET-50219-57) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. [Preliminary Safety Analysis Report], Amendment 53. (Jersey Central Power and Light Co., Morristown, N. J.). June 16, 1969. 153p. Dep. CFSTI.

Test results for stainless steel pipes and valves for the emergency core cooling system are presented. Inspection results for emergency core cooling system pipes and fittings are included. (D.C.C.)

52230 (DOCKET-50219-58) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. Report of Excessive Rod Drop Times. (Jersey Central Power and Light Co., Morristown, N. J.). Oct. 14, 1969. 4p. Dep. CFSTI.

Modifications of the control rod drives to improve scram performance are described. (D.C.C.)

52231 (DOCKET-50220-28) NINE MILE POINT NUCLEAR STATION. Final Safety Analysis Report, Amendment 5, Suppl. 1, Exhibit D-3. (Niagara Mohawk Power Corp., Syracuse, N. Y.). May 1968. 170p. Dep. CFSTI.

The performance of the Emergency Core Cooling System for the Nine Mile Point Power Reactor is evaluated in detail. Changes in core spray nozzle configuration are described; safety implications of the changes are analyzed. Cooling pump and containment spray characteristics are discussed. The design of the core spray piping and sparger ring is described. Effects of leakage from the primary system into the dry well are analyzed. Cooling system transient response is discussed. The quality assurance program and inspections for the cooling systems are tabulated. The safety functions and set-points of the radiation monitors are described. Facilities which permit continuous occupancy of the control room following a design basis accident (DBA) are described. A failure mode and effect analysis of the a.c. system is given. Details relating to the diesel generator are discussed. Coolant activities are tabulated. A radiological analysis of the equalization of drywell and suppression chamber pressures is detailed. Emergency plans are outlined in detail. Other operations details are described. (M.L.S.)

52232 (DOCKET-50237-15) DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3. [Supplementary Information], Amendment 13 for Unit 2 and Amendment 14 for Unit 3. (Commonwealth Edison Co., Chicago, Ill.). July 8, 1969. 227p. (DOCKET-50249-16). Dep. CFSTI.

Additional information is presented for the Dresden Power Reactor Units 2 and 3. Stress analyses of the torus and reactor support structure under seismic conditions are described. Qualifications for startup and operation personnel are listed. Emergency power systems are described. Power conversion system instrumentation failures are analyzed. Diagrams of the control room and shielding safety during accident conditions are included. Radiation monitoring equipment for the reactor site is described. (D.C.C.)

52233 (DOCKET-50237-17) DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3. Safety Analysis Report, Vol. 1. (Commonwealth Edison Co., Chicago, Ill.). Nov. 17, 1967. 452p. (DOCKET-50249-18). Dep. CFSTI.

Information on Dresden Power Reactor Units 2 and 3 is presented under the following broad topics: Introduction and Summary; Site; Reactor; Reactor Coolant System; Containment Systems; and Engineered Safeguards. (D.C.C.)

52234 (DOCKET-50237-18) DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3. Amendment 20 for Unit 2 and Amendment 21 for Unit 3. (Commonwealth Edison Co., Chicago, Ill.). Oct. 16, 1969. 28p. (DOCKET-50249-19). Dep. CFSTI.

Additional data are presented on the seismic dynamic analyses of the piping inside the drywell. A summary of the statically evaluated systems for the Design Basis Earthquake is included. (H.D.R.)

52235 (DOCKET-50237-19) DRESDEN NUCLEAR POWER STATION, UNIT 2. Notice of Issuance of Proposed Provisional Operating License. (Commonwealth Edison Co., Chicago, Ill.). Oct. 13, 1969. 50p. Dep. CFSTI.

52236 (DOCKET-50245-17) MILLSTONE NUCLEAR POWER STATION, UNIT 1. [Final Safety Analysis Report], Amendment 17. (Connecticut Light and Power Co., Hartford. Hartford Electric Light Co., Conn. Western Massachusetts Electric Co., Greenfield. Millstone Point Co., Wethersfield, Conn.). Oct. 3, 1969. 145p. Dep. CFSTI.

A description of the on-site emergency first aid and decontamination equipment is presented. Qualifications of on-site medical staff and safety personnel are listed. Emergency procedures for injured and contaminated personnel are described. Available offsite facilities for injured and contaminated personnel are also described. Emergency power systems are illustrated. Stress analyses of torus and containment structures under seismic conditions are presented. Piping stresses are also calculated. Qualifications of personnel involved in startup and operation of the power plant are listed. Auxiliary water systems are described. Emergency equipment for fission product release assumptions is described. Accident dose rate calculations for the control room are presented. (D.C.C.)

52237 (DOCKET-50247-9) INDIAN POINT NUCLEAR GENERATING UNIT NO. 2. Preliminary Safety Analysis Report, Exhibit B-1, Suppl. 1. (Consolidated Edison Co. of New York, Inc., New York). Mar. 31, 1966. 284p. Dep. CFSTI.

Revised information on the design of the Indian Point Power Reactor Unit 2 is presented. Information is presented on the topics of: cooling system; control systems; containment systems; and engineered safeguards. Coolant loss conditions and responses are analyzed. Stress analysis for containment system penetrations is presented. (D.C.C.)

52238 (DOCKET-50247-10) INDIAN POINT NUCLEAR GENERATING UNIT NO. 2. PLANT DESIGN DESCRIPTION AND SAFETY ANALYSIS. Final Facility Description and Safety Analysis Report, Amendment 10, Exhibit B-8, Vol. 5. (Consolidated Edison Co. of New York, Inc., New York). Oct. 13, 1969. 187p. Dep. CFSTI.

Revised information on the Indian Point Power Reactor Unit 2 is presented. Emergency procedures and equipment for injury and contaminated personnel are described. Qualifications of on-site medical staff and safety personnel are listed. Flood data for the reactor site are analyzed. Stress analysis for battery racks is included. Design drawings of containment structures are presented. Stress analysis of containment penetrations is described. (D.C.C.)

52239 (DOCKET-50261-13) H. B. ROBINSON UNIT NO. 2. Preoperational Environment Surveillance Program. Quarterly Report. (NUS Corp., Rockville, Md.). Apr. 22, 1969. 16p. (NUS-TM-S-83). Dep. CFSTI.

For Carolina Power and Light Co., Raleigh, N. C.

52240 (DOCKET-50261-14) H. B. ROBINSON UNIT NO. 2. Preoperational Environment Surveillance Program. Interim Report No. 2. (NUS Corp., Rockville, Md.). Sept. 4, 1969. 12p. (NUS-TM-S-90). Dep. CFSTI.

For Carolina Power and Light Co., Raleigh, N. C.

52241 (DOCKET-50263-29) MONTICELLO NUCLEAR GENERATING PLANT, MONTICELLO, MINNESOTA, UNIT 1. Final Safety Analysis Report, Amendment 19. (Northern States Power Co., Minneapolis, Minn.). Oct. 3, 1969. 11p. Dep. CFSTI.

Revised information concerning the emergency systems of the Monticello Power Reactor Unit 1 is presented. Actuation circuitry for the ECCS and containment spray system is described and illustrated. (D.C.C.)

52242 (DOCKET-50263-30) MONTICELLO NUCLEAR GENERATING PLANT, MONTICELLO, MINNESOTA, UNIT 1. Final Safety Analysis Report, Amendment 20. (Northern States Power Co., Minneapolis, Minn.). Oct. 13, 1969. 432p. Dep. CFSTI.

Amendments 16, 17, and 19 are incorporated into the Final Safety Analysis Report. Information is included on: the site, seismology, core performance, pressure vessel, cooling system, containment system, emergency and auxiliary systems, control systems and instrumentation, plant electrical systems, plant safety, quality assurance programs, and pre-operational and startup tests. (H.D.R.)

52243 (DOCKET-50263-31) MONTICELLO NUCLEAR GENERATING PLANT, MONTICELLO, MINNESOTA, UNIT 1. Final Safety Analysis Report, Amendment 21. (Northern States Power Co., Minneapolis, Minn.). Oct. 15, 1969. 239p. Dep. CFSTI.

Responses to questions on plant structural and seismic design aspects are presented. Included are additional information on plant operations and additional supplemental information on design. (H.D.R.)

52244 (DOCKET-50269-10) OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3. Environmental Radiological Monitoring Program. (Duke Power Co., Charlotte, N. C.). Oct. 21, 1969. 76p. (DOCKET-50270-10; DOCKET-50287-7; CONF-680516-2; CONF-690630-1; CONF-680907-2). Dep. CFSTI.

From ASCE Environmental Conference, Chattanooga, Tenn. 37th Annual Convention of Edison Electric Institute, Portland, Ore. Conference of Research Needs, Pullman, Wash.

52245 (DOCKET-50285-18) FORT CALHOUN REACTOR. Pre-Operational Environmental Survey, 4th Quarter, 1968. (Tracerlab/West, Richmond, Calif.). Oct. 9, 1969. 23p. Dep. CFSTI.

For Omaha Public Power District, Nebr.

52246 (DOCKET-50285-19) FORT CALHOUN REACTOR. Pre-Operational Environmental Survey, 1st Quarter, 1969. (Tracerlab/West, Richmond, Calif.). May 16, 1969. 8p. Dep. CFSTI.

For Omaha Public Power District, Nebr.

52247 (DOCKET-50285-20) FORT CALHOUN REACTOR. Pre-Operational Environmental Survey, 2nd Quarter, 1969. (Tracerlab/West, Richmond, Calif.). Aug. 1969. 7p. Dep. CFSTI.

For Omaha Public Power District, Nebr.

52248 (DOCKET-50285-21) FORT CALHOUN STATION, UNIT NO. 1. [Pre-Operational] Environmental Radiation Monitoring. (Omaha Public Power District, Nebr.). Sept. 1969. 9p. Dep. CFSTI.

52249 (DOCKET-50289-17) THREE MILE ISLAND NUCLEAR STATION, UNIT 1. SUMMARY OF AIRCRAFT IMPACT DESIGN. (Gilbert Associates, Inc., Washington, D. C.). Sept. 4, 1969. 46p. Dep. CFSTI.

For Metropolitan Edison Co., Reading, Pa.

The design of structures at the Three Mile Island Power Reactor, Unit 1 for aircraft impact-resistance is summarized. Analyses of the reactor building reactor building shell at various spots and a plate analysis which serves as the basis for wall and roof slab designs are detailed for aircraft weight of 2×10^5 lbs. and 200 knots. Effects of aircraft impact loading on prestress force are considered. The possibility of containment-linear anchors spalling under aircraft impact loading is evaluated. (M.L.S.)

52250 (DOCKET-50302-11) CRYSTAL RIVER NUCLEAR GENERATING PLANT, UNIT 3. Environmental Report. (Florida Power Corp., St. Petersburg). Sept. 22, 1969. 28p. Dep. CFSTI.

52251 (DOCKET-50309-17) MAINE YANKEE ATOMIC POWER STATION. Preliminary Safety Analysis Report, Vol. 1. (Maine Yankee Atomic Power Co., Wiscasset). Sept. 27, 1967. 409p. Dep. CFSTI.

Financial data on the owners of the Maine Yankee Power Reactor are presented in support of the application for construction permit and operating license. A schedule of estimated expenditures for the plant is given. Information on the Maine Yankee Power Reactor is presented under the following broad topics: Site and Evirons; Reactor; Reactor Coolant System; Reactor Containment; and Engineered Safeguards. (D.C.C.)

52252 (DOCKET-50312-12) RANCHO SECO NUCLEAR GENERATING STATION, UNIT 1. Preliminary Safety Analysis Report, Amendment 2. (Sacramento Municipal Utility District, Calif.). Apr. 15, 1968. 841p. Dep. CFSTI.

The results of a six-weeks meteorological study at the plant site are presented. The geophysical characteristics of the site are reported. The likelihood and intensity of earthquakes at the site are estimated. Engineering properties of the soil and foundation are described. Revised pages are included for the PSAR and Appendices. A new appendix on the Rancho Seco project engineering staff is provided. Responses are presented to questions concerning: cooling system activity levels; distance to the low population zone; off-site thyroid doses under inversion conditions; earthquake epicenter maps; fast neutron flux at the pressure vessel inner surface; loading criteria in large component design; post accident dose levels in the containment; iodine removal capability of the containment spray systems; radiolytic and chemical hydrogen formation under post accident conditions; quality assurance and quality control groups organizational charts; analysis of loss of load transients; natural circulation characteristics of the primary system; and energy yield and pressure pulse predictions for the rod ejection accident. (H.D.R.)

52253 (DOCKET-50313-14) ARKANSAS NUCLEAR ONE. DARDANELLE RESERVOIR: BACKGROUND SURVEY. (Arkansas Power and Light Co., Little Rock). Sept. 17, 1969. 35p. Dep. CFSTI.

A proposal is presented for a program for testing and reporting on temperatures, biological conditions, chemical conditions, and radiological conditions of the sections of the Dardanelle Reservoir which might be influenced by the Russellville plant. Data obtained for the second half of the first year of pre-operational study are included. (H.D.R.)

52254 (DOCKET-50313-15) [ARKANSAS NUCLEAR ONE]. Preliminary Safety Analysis Report, Amendment 12. (Arkansas Power and Light Co., Little Rock). Oct. 13, 1969. 15p. Dep. CFSTI.

Included are: (1) comments on the analysis of the base slab tendon anchorage zone; (2) a sketch of the reinforcing bar pattern in the containment base with supporting stress analyses; and (3) a letter authorizing the release of some proprietary information in Supplement J of the PSAR. (H.D.R.)

52255 (DOCKET-50327-8) SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2. Soils Investigation Data. (Tennessee Valley Authority, Knoxville). Oct. 6, 1969. 9p. (DOCKET-50328-8). Dep. CFSTI.

The results obtained for four deep holes drilled under the location for each reactor building as a part of the foundation investigations are presented. (H.D.R.)

52256 (DOCKET-50327-9) SEQUOYAH NUCLEAR PLANT, [UNITS 1 AND 2]. Exploratory Drilling Program, September-October, 1969. (Tennessee Valley Authority, Knoxville). Oct. 10, 1969. 48p. (DOCKET-50328-9). Dep. CFSTI.

Information concerning geological conditions of the proposed site for Sequoyah Power Reactor Units 1 and 2 is presented. Diagrams illustrating drilling data are included. (D.C.C.)

52257 (DOCKET-50327-10) SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 5. (Tennessee Valley Authority, [Knoxville]). Oct. 6, 1969. 55p. (DOCKET-50328-10). Dep. CFSTI.

Additional information concerning the emergency power system is presented. The training program for plant personnel is described. Supervision of plant operations is outlined. In-service inspection procedures for the cooling system are described. Leak rate limits for the primary system are analyzed. Plant access security is discussed. Emergency procedures for a fuel handling

accident are listed. Radiological consequences of a ruptured steam generator tube in the secondary system are analyzed. (D.C.C.)

52258 (DOCKET-50329-6) [MIDLAND PLANT, UNITS 1 AND 2]. Preliminary Safety Analysis Report, Amendment 4. (Consumers Power Co., Jackson, Mich.). Oct. 2, 1969. 36p. (DOCKET-50330-6). Dep. CFSTI.

Design parameters of the emergency spray system are presented. Flow diagram of the spray system is included. Quality assurance procedures and requirements are described. (D.C.C.)

52259 (DOCKET-50331-12) DUANE ARNOLD ENERGY CENTER. Preliminary Safety Analysis Report, Amendment 6. (Iowa Electric Light and Power Co., Cedar Rapids). Sept. 25, 1969. 42p. Dep. CFSTI.

Responses are presented to questions concerning: loading criteria in component design; design requirements for pressure piping; interlock functions performed by the reactor system mode switch; loading criteria in steam line anchor point design; consequences of accidental dropping of a fuel cask. Revised data are included on the design of the pressure suppression containment system and the electrical power systems. (H.D.R.)

52260 (DOCKET-50333-8) JAMES A. FITZPATRICK NUCLEAR POWER PLANT. Preliminary Safety Analysis Report, Amendment 5, Suppl. 4. (Power Authority of the State of New York). Oct. 2, 1969. 24p. Dep. CFSTI.

Revised information on the primary containment torus and vent pipes and materials is presented. Included are responses to questions concerning seismic design and analysis of Class I structures and systems and design, construction, and stress evaluation of the containment drywell. (H.D.R.)

52261 (DOCKET-50333-9) JAMES A. FITZPATRICK NUCLEAR POWER PLANT. Preliminary Safety Analysis Report, Amendment 6. (Power Authority of the State of New York). Oct. 22, 1969. 55p. Dep. CFSTI.

Safety limits for emergency systems are described. Seismic design limits for emergency systems are also described. Power cable penetrations are analyzed. Operating conditions for emergency systems during coolant loss or steam-line-break accident are listed. The emergency power and shutdown systems are described. (D.C.C.)

52262 (DOCKET-50344-5) [TROJAN NUCLEAR PLANT]. Preliminary Safety Analysis Report, Amendment 2. (Portland General Electric Co., Oreg.). Oct. 13, 1969. 318p. Dep. CFSTI.

QUALITY CONTROL —program for fabrication of Trojan Power Reactor fuel elements
TROJAN POWER-REACTOR, UNIT 1 —site for, revised and supplementary data on
—core for, revised and supplementary data on
—buildings and structures design for, revised and supplementary data on
—containment systems for, revised and supplementary data on
—emergency and auxiliary systems for, revised and supplementary data on
—control systems and instrumentation for, revised and supplementary data on
—electrical systems for, revised and supplementary data on
—cooling system for, revised and supplementary data on
—steam and power conversion system for, revised and supplementary data on
—radiation protection and waste disposal for, revised and supplementary data on
—engineered safeguards for, revised and supplementary data on
—fuel element fabrication for, reliability and quality assurance program for (H.D.R.)

52263 (DOCKET-50348-1) SEALA NUCLEAR PLANT, UNIT 1. LICENSE APPLICATION. Preliminary Safety Analysis Report. (Alabama Power Co., Birmingham). Oct. 15, 1969. 75p. Dep. CFSTI.

SEALA POWER REACTOR, UNIT 1 —license for, application for (M.L.S.)

52264 (DOCKET-50348-2) SEALA NUCLEAR PLANT, UNIT 1. Preliminary Safety Analysis Report, Vol. 1. (Alabama Power Co., Birmingham). Oct. 15, 1969. 498p. Dep. CFSTI.

SEALA POWER REACTOR, UNIT 1 —site for, preliminary safety analysis of
—core for, preliminary safety analysis of design for
—cooling system for, preliminary safety analysis of design for
—containment system for, preliminary safety analysis of (M.L.S.)

52265 (DOCKET-50348-3) SEALA NUCLEAR PLANT, UNIT 1. Preliminary Safety Analysis Report, Vol. 2. (Alabama Power Co., Birmingham). Oct. 15, 1969. 473p. Dep. CFSTI.

SEALA POWER REACTOR UNIT 1 —engineered safeguards for, preliminary safety analysis of
—control system and instrumentation for, preliminary safety analysis of
—electrical systems for, preliminary safety analysis of
—emergency and auxiliary systems for, preliminary safety analysis of (M.L.S.)

52266 (DOCKET-50348-4) SEALA NUCLEAR PLANT, UNIT 1. Preliminary Safety Analysis Report, Vol. 3. (Alabama Power Co., Birmingham). Oct. 15, 1969. 245p. Dep. CFSTI.

SEALA POWER REACTOR, UNIT 1 —radiation protection and radioactive waste disposal at, preliminary safety analysis of
—operation of, preliminary safety analysis of proposed
—steam and power conversion systems for, preliminary safety analysis of
—safety analysis for (M.L.S.)

52267 (DOCKET-50348-5) SEALA NUCLEAR PLANT, UNIT 1. Preliminary Safety Analysis Report, Vol. 4. (Alabama Power Co., Birmingham). Oct. 15, 1969. 322p. Dep. CFSTI.

SEALA POWER REACTOR, UNIT 1 —design of, comparison of AEC General Design criteria and
—site for, details on geology, hydrology, seismology, and soils at
—pressure vessel for, determination of NDTT for
—structures and systems for, seismic design bases for
—containment structures for, finite element analysis of
—containment systems for, description of instrumentation for (M.L.S.)

52268 (GA-9356) TESTS RELATING TO CORROSION PROTECTION FOR TENDONS OF THE PUBLIC SERVICE COMPANY OF COLORADO PRESTRESSED CONCRETE REACTOR VESSEL. Hildebrand, J. F. (Gulf General Atomic, Inc., San Diego, Calif.). Aug. 6, 1969. Contract AT(04-3)-633. 100p. Dep. CFSTI.

The nongrouted tendons of the Fort St. Vrain Nuclear Generating Station require corrosion protection starting at the wire manufacturer's works and continuing through the life of the prestressed concrete reactor vessel. To ensure the adequacy of the corrosion-protection system, a variety of coating materials applied to wires and tendons were evaluated after exposure to several environments. The purpose of each test, the environments, and the results are summarized. The results of these accelerated tests have demonstrated that the prescribed phosphate coating on the wires and the No-Ox-Id CM corrosion-inhibiting compound on the tendons provide excellent corrosion protection that can be expected to last throughout the life of the prestressed concrete reactor vessel. (auth)

52269 (JUL-571-RG) STUDIES ON THE LOAD BEHAVIOR OF THE THTR 300-MW PROTOTYPE POWER PLANT. Hansen, Ulf (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorentwicklung). Jan. 1969. 160p. (In German). Dep.

A quasistationary calculation model is developed for the calculation of the effect of the daily and weekly load operations on the THTR prototype power plant. With this model the slowly occurring alterations, which correspond to the daily load behavior, can be calculated. A series of stationary states is used to describe the time dependence. The calculation model represents both the coupling between nuclear and thermodynamic processes in the core and also that between primary and secondary circuits. The power pattern is given as a random consequence of step-like and ramp-like changes. The time- and space-dependent load-induced oscillations of the xenon concentration are calculated. The behavior of the whole power plant is investigated at various partial loads and for a number of special load diagrams. (tr-auth)

52270 (TID-25199) GUNDREMMINGEN NUCLEAR POWER PLANT. Monthly Report, June 1967. (Kernkraftwerk RWE-Bayernwerk G.m.b.H., Gundremmingen (West Germany)). 38p. (In German). Dep. CFSTI.

52271 (TID-25212) GUNDREMMINGEN NUCLEAR POWER PLANT MONTHLY REPORT, JANUARY 1968. (Kernkraftwerk RWE-Bayernwerk G.m.b.H., Gundremmingen (West Germany)). Feb. 9, 1968. 52p. (In German). Dep. CFSTI.

52272 (TID-25213) GUNDREMMINGEN NUCLEAR POWER PLANT MONTHLY REPORT, FEBRUARY 1968. (Kernkraftwerk RWE-Bayernwerk G.m.b.H., Gundremmingen (West Germany)). Mar. 13, 1968. 52p. (In German). Dep. CFSTI.

Maintenance and operation during February 1968 are described. Radiation doses for the personnel and monitoring measurements for the reactor are listed. (D.C.C.)

52273 (TID-25214) GUNDREMMINGEN NUCLEAR POWER PLANT MONTHLY REPORT, MARCH 1968. (Kernkraftwerk RWE-Bayernwerk G.m.b.H., Gundremmingen (West Germany)). 43p. (In German). Dep. CFSTI.

Maintenance and operation during March 1968 are described. Radiation doses for the personnel and monitoring measurements for the reactor are listed. (D.C.C.)

52274 (TID-25215) GUNDREMMINGEN NUCLEAR POWER PLANT MONTHLY REPORT, APRIL 1968. (Kernkraftwerk RWE-Bayernwerk G.m.b.H., Gundremmingen (West Germany)). May 9, 1968. 45p. (In German). Dep. CFSTI.

Maintenance and operation during April 1968 are described. Radiation doses for the personnel and monitoring measurements for the reactor are listed. (D.C.C.)

52275 (TID-25216) GUNDREMMINGEN NUCLEAR POWER PLANT MONTHLY REPORT, MAY 1968. (Kernkraftwerk RWE-Bayernwerk G.m.b.H., Gundremmingen (West Germany)). June 18, 1968. 61p. (In German). Dep. CFSTI.

Maintenance and operation during May 1968 are described. Radiation doses for the personnel and monitoring measurements for the reactor are listed. (D.C.C.)

52276 (TID-25217) GUNDREMMINGEN NUCLEAR POWER PLANT MONTHLY REPORT, JUNE 1968. (Kernkraftwerk RWE-Bayernwerk G.m.b.H., Gundremmingen (West Germany)). July 11, 1968. 40p. (In German). Dep. CFSTI.

Maintenance and operation during June 1968 are described. Radiation doses for the personnel and monitoring measurements for the reactor are listed. (D.C.C.)

52277 (TID-25218) GUNDREMMINGEN NUCLEAR POWER PLANT MONTHLY REPORT, JULY 1968. (Kernkraftwerk RWE-Bayernwerk G.m.b.H., Gundremmingen (West Germany)). Aug. 2, 1968. 50p. (In German). Dep. CFSTI.

Maintenance and operation during July 1968 are described. Radiation doses for the personnel and monitoring measurements for the reactor are listed. (D.C.C.)

52278 (TID-25219) GUNDREMMINGEN NUCLEAR POWER PLANT MONTHLY REPORT, AUGUST 1968. (Kernkraftwerk RWE-Bayernwerk G.m.b.H., Gundremmingen (West Germany)). Sept. 10, 1968. 52p. (In German). Dep. CFSTI.

Maintenance and operation during August 1968 are described. Radiation doses for the personnel and monitoring measurements for the reactor are listed. (D.C.C.)

52279 (TID-25220) GUNDREMMINGEN NUCLEAR POWER PLANT. Monthly Report, September 1968. (Kernkraftwerk RWE-Bayernwerk G.m.b.H., Gundremmingen (West Germany)). Oct. 14, 1968. 57p. (In German). Dep. CFSTI.

52280 (TID-25221) GUNDREMMINGEN NUCLEAR POWER PLANT MONTHLY REPORT, OCTOBER 1968. (Kernkraftwerk RWE-Bayernwerk G.m.b.H., Gundremmingen (West Germany)). Nov. 15, 1968. 41p. (In German). Dep. CFSTI.

Maintenance and operation during October 1968 are described. Radiation doses for the personnel and monitoring measurements for the reactor are listed. (D.C.C.)

52281 (TID-25222) GUNDREMMINGEN NUCLEAR POWER PLANT MONTHLY REPORT, NOVEMBER 1968. (Kernkraftwerk RWE-Bayernwerk G.m.b.H., Gundremmingen (West Germany)). Dec. 18, 1968. 47p. (In German). Dep. CFSTI.

52282 (TID-25223) GUNDREMMINGEN NUCLEAR POWER PLANT MONTHLY REPORT, DECEMBER 1968. (Kernkraftwerk RWE-Bayernwerk G.m.b.H., Gundremmingen (West Germany)). Jan. 15, 1969. 42p. (In German). Dep. CFSTI.

Maintenance and operation during December 1968 are described. Radiation doses for the personnel and monitoring measurements for the reactor are listed. (D.C.C.)

52283 (WCAP-2928) SAXTON CORE I NUCLEAR OPERATIONS SUMMARY. Impink, A. J.; Kutz, J. P. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). Mar. 1966. 235p.

The Saxton Core 1 is described and its operating history is summarized. The most important results of the physics test program are examined. Measurements on the reactivity kinetics coefficients, fuel depletion, core power distribution, and physico-chemical aspects of Core 1 operation are presented. (H.D.R.)

52284 KINETICS AND CONTROL OF NUCLEAR POWER STATIONS. Fonteray, M. J. pp 189-209 of Genie Atomique. Tome II. Saclay, France, Institut National des Sciences et Techniques Nucleaires. Paris, Presses Universitaires de France, 1968. (In French).

The objectives in the study of the kinetics and control of nuclear assemblies are defined. The general principles and methods suitable for these purposes are described. In an appendix the concepts of the transfer function, transfer matrix, and control and regulation are defined. (J.S.R.)

52285 PROCEDURE FOR LICENSING NUCLEAR POWER PLANTS IN THE LIGHT OF EXPERIENCE ACQUIRED OVER A THREE YEAR PERIOD. Nocera, Fabrizio; Di Loreto, Angelo. Ing. Nucl., 10: 33-6(Jan.-Feb. 1969). (In Italian).

The procedures for licensing of Italian power reactors are described. Topics for which safety analyses are required are listed. The functions of the safety group within the CNEN are outlined. (M.L.S.)

52286 PLAN WELL FOR A NUCLEAR OPERATING LICENSE. Rhode, G. K. (Niagara Mohawk Power Corp., Syracuse, N. Y.). Power, 113: No. 9, 76-7(Sept. 1969).

Some of the general time-consuming aspects of the operating license process for U. S. nuclear power plants are discussed. The scheduling of licensing activities by the utility, engineering manpower requirements, costs, and backfitting problems are examined. The importance of allowing enough time for AEC reviews is emphasized by the estimated $65,000 daily cost of startup delay. (H.D.R.)

52287 SPECIAL ASPECTS OF HIGH CURRENT NUCLEAR POWER PLANTS. Bornebroek, D. J. (Gemeenschappelijke Kernenergiecentrale, Arnhem, Netherlands). Electrotechniek, 46: 227-33(May 30, 1968). (In Dutch).

Some special aspects of the electrical installation in the Dodewaard nuclear power station are described. Attention is paid to special power supplies, such as a dieselgenerator, motorgenerator-sets, to the reactor protection system, and to the cabling. A short description is given of the functions of the datalogger. (auth)

52288 IN-CORE POWER MEASUREMENT INSTRUMENTS FOR THE DODEWAARD POWER REACTOR. Vriese, A. (Gemeenschappelijke Kernenergiecentrale, Arnhem, Netherlands). Electrotechniek, 46: 233-8(May 30, 1968). (In Dutch).

In-core instrumentation and the need for it is described. A description of the traversing in-core probe and a fixed in-core system used in the nuclear power plant at Dodewaard is presented. (auth)

52289 NONDESTRUCTIVE TESTING OF DODEWAARD POWER REACTOR COMPONENTS. van der Meer, J.; de Jong, J. J. R. Electrotechniek, 46: 307-12(July 25, 1968). (In Dutch).

Non-destructive test methods for welded joints in the reactor are described. Ultrasonic inspection of the pressure vessel is discussed. (auth)

52290 REACTOR PRESSURE VESSEL STEEL TESTING PROGRAM FOR THE DODEWAARD POWER REACTOR. Schumacher, K.; Wassenaar, K. (Algemeen Onderzoek en Technologie, Arnhem, Netherlands). Electrotechniek, 46: 312-21(July 25, 1968). (In Dutch).

A surveillance system is described for monitoring the embrittlement of pressure vessel steel during reactor lifetime. The effects of reactor lifetime on steel embrittlement are analyzed. (auth)

52291 BULLETIN ON THE COMMISSION OF THE EUROPEAN COMMUNITY. Ing. Nucl., 10: No. 2, 54-5(Mar.-Apr. 1969). (In Italian).

The reactors which are operating, under construction, or being planned in the European Community are tabulated according to type and according to country. Each country's participation in the Community is discussed briefly. (M.L.S.)

52292 SELECTED MATERIALS ON ENVIRONMENTAL EFFECTS OF PRODUCING ELECTRIC POWER. JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES, NINTY-FIRST CONGRESS, FIRST SESSION, AUGUST 1969. Washington, D. C., Joint Committee on Atomic Energy, 1969. 560p. GPO $2.50.

Background documents dealing with the environmental effects of nuclear and fossil fueled steam power plants are presented. Selected excerpts from the JCAE hearings on the AEC fiscal 1970

...tion and the JCAE report on this authorizing ...el. Other materials incorporated deal with ...eric pollution, and radiological dis... ...facts. Two reports—Considera... ...Site Selection and Problems in ...Electric Plants—are in...

...STATIONS IN ...y, Gas - ...on

...The location-independent nuclear power station pres... ...deal case for water economy and has advantages for econ... ...energy as well. It would require water neither as cooling me... ...terial nor for the removal of liquid activity. Water economies ...could serve its goal here best if it opposes power projects in ...a transition state of development with generally well-defined ...limitations. The most recent experiments with warming of ...river waters to 28°C were satisfactory and indicate possibility ...of attainment of such temperatures elsewhere. The legally per... ...mitted quantities of radioactive material to be introduced into ...drains is so carefully established that a further reduction will ...not be called for. Consideration of the safety of drinking water ...from groundwater sources indicates no reason for concern in ...light of present technology and knowledge. (BBB)

52294 NUCLEAR POWER STATIONS AND GROUND WATER UTILIZATION: A TASK OF WATER ECONOMIC PLANNING. Schwille, Fr. Gas- Wasserfach., 110: 646(June 13, 1969). (In German).

The use of ground water for removal of heat from nuclear power plants has the lowest cost; if the minimum needed quantity is 20 m^3/sec, only the Rhine, Neckar, Main, Moselle, Weser, Elbe, Danube, and Alpine tributaries need be considered in the interior of Germany. The most plentiful groundwater conductors are the fluvial sediments of the lower terraces accompanying these rivers. Protection of water in the major ground water reservoirs is of greatest importance. Nuclear stations are strictly controlled and present no greater danger than conventional stations. Technology must be applied to the control of radioactive wastes, but the major problem is the quantity of heat to be dispersed. Systematic groundwater studies on potential cooling water reserves and thermal loading of drains are needed to complement other studies on shore filtration, artificial ground water expansion, and ground water reservoirs with consideration not only to Germany's welfare but that of neighboring countries depending on the same rivers. (BBB)

52295 THE INFLUENCE OF GROWTH OF UNITARY POWER OF THERMAL AND NUCLEAR GROUPS ON INTERNATIONAL ENERGY EXCHANGES IN WESTERN EUROPE. Goldsmith, K. (Electrowatt Ingenieurs-Conseils, Zurich); Luder, H. A.; Wahl, J. Bull. Schweiz. Elektrotech. Ver., 60: 685-92(July 19, 1969). (In French).

Power increase is a result of consumption increases, increases in sizes of units, and increasing yield as unit size increases. Specific price lowerings are noted: 42% in 10 years for natural U reactors, 5% in 1 year for advanced reactors, and 5% for light water reactors. The size of unitary power is limited by necessary reserves, partial indisposition of large units, existing means of transport, and network stability. Restrictions may be met by accumulation hydraulic plants, stability for interconnected systems through very large turning masses, and contributions from the total reserve for lost power. (BBB)

52296 DETAILS OF THE AUTOMATION OF THE NUCLEAR POWER STATION OF MONTS D'ARREE. Fauve, Jean-Michel (Centrale des Monts d'Arree, Brennelis, France). Automatisme, 14: 235-42(June 1969). (In French).

The automation of the Monts d'Arree station is described in terms of the computer, relay system, and series of regulation devices. Utilization of various programmed and cabled logics is illustrated. Staffing for further use of automation is described, and a brief history of applications at the plant is given. (BBB)

52297 ARRANGEMENTS FOR SUPERVISING THE OPERATIONAL RELIABILITY OF LARGE STEAM TURBINES IN NUCLEAR POWER STATIONS. Kahlert, Werner. At. Strom, 15: 113-16(July-Aug. 1969). (In German).

The special characteristics of the control arrangement for large steam turbines in nuclear power stations are examined. In principle it is found that the control devices which have been found reliable in operation in superheated-steam machines have also been adopted for the large steam turbines in nuclear power stations. Some special problems are encountered with saturated-steam turbines and they require additional devices in order to achieve the desired high level of operational reliability. (auth)

52298 EXAMINATIONS OF CONTAMINATION ON THE DIRECT ADMITTED TURBINE OF THE NUCLEAR POWER STATION GUNDREMMINGEN. Lindner, Ludwig; Ammentorp-Schmidt, Fritz; Weidinger, Hans-Georg; Eickelpasch, Norbert. At. Strom, 15: 117-19(July-Aug. 1969). (In German).

The nuclear power station Gundremmingen, which is equipped with a boiling water reactor, has a 250-MW-saturated steam turbine working in direct circulation. The contamination of turbine by radioactive products was examined after one year. As the contamination was very low, maintenance and repair works were made directly on the turbine. An extrapolation of measured values shows that an essential increase of contamination is not to be expected. (auth)

52299 DODEWAARD: THE FIRST DUTCH NUCLEAR POWER STATION. Mackenthun, Werner (VDEW-Geschaeftsstelle, Frank...t am Main). At. Strom, 15: 130-3(July-Aug. 1969). (In Ger...

The ...tory of the design and construction of the Dodewaard nuclear ...r plant is discussed. A description of the plant site and technic... ...ts on the plant are presented. (H.D.R.)

52300 NUC... POWER: REDUCING THE RISK. Technol. Rev., 71: 73-4(July ...69).

Several assessment... the hazards to the public of nuclear power developments are ...fly discussed. A U.S. Atomic Energy Commission spokesman has ...ted that with existing techniques and knowledge, the total risks ...he public from nuclear power plants, although very small, cann... ...ow be meaningfully expressed numerically. However, a represent... ...of the U.K. Atomic Energy Authority, has taken a different view, ...icating that the danger to the population from reactor accidents ca... ...be stated in terms of increased risk of various cancers. It is po... ...ible to cite relation between amount and type of fission products ...eased and number of cancer cases (above the general level) there... ...induced. Thus, an objective can be stated, in the form of a graph which specifies the maximum allowable annual probability of releasing any given amount of ^{131}I (or its equivalent) up to the total content of the reactor. (BBB)

52301 SAFETY-RELATED OCCURRENCES REPORTED IN JUNE-JULY 1969. Casto, W. R. Nucl. Safety, 10: 530-4(Nov.-Dec. 1969).

The following safety-related occurrences which were reported in June–July 1969 are summarized: high radiation levels in occupied apartments from improperly stored radioactive materials in adjoining plant; plutonium storage drain leakage; fuel failures in the Big Rock Point Power Reactor; load rejection at Indian Point-1 caused by two people climbing a tie-line tower; overexposures during radiography caused by misinterpretation of survey meter anomaly; electronic noise mistaken as neutrons during Texas A and M TRIGA startup; GGA TRIGA transient-rod scram failure; loss of off-site power at Connecticut Yankee; and common failure mode in TRIGA scram circuit. 18 references. (M.L.S.)

52302 ACTION ON REACTOR AND OTHER PROJECTS UNDERGOING REGULATORY REVIEW OR CONSIDERATION. Blakely, J. P. Nucl. Safety, 10: 550-9(Nov.-Dec. 1969).

Regulatory actions or reviews are summarized for the following reactors: Bell (Docket 50-319); Brunswick 1 and 2 (Dockets 50-324 and 50-325); Calvert Cliffs 1 and 2 (Dockets 50-317 and 50-318); Ginna (Docket 50-244); Ver Planck 1 and 2 [Indian Point 4 and 5] (Dockets 50-342 and 50-343); Monticello (Docket 50-263); Oyster Creek (Docket 50-219); Surry 1 and 2 (Dockets 50-280 and 50-281); Three Mile Island 2 (Docket 50-320); and Trojan (Docket 50-344). 14 references. (M.L.S.)

Power Reactor Development

Refer also to abstracts 50100, 50977, 50986, 51077, 51078, 52291, 52429, and 52451.

52303 (CONF-680328-(Absts.)) AMERICAN NUCLEAR 1968 STUDENT CONFERENCE FOR THE WESTERN STATES. PROGRAM AND GENERAL INFORMATION. (Arizona Univ., Tucson). Mar. 1968. 69p. Dep. CFSTI.

Separate abstracts are included for the 27 papers presented at 1968 ANS Student Conference. (D.C.C.)

52304 (CTC-INF-32(Rev.1)) CHORD-S: A SYSTEM OF PROGRAMS FOR COMPUTER HANDLING OF REACTOR DATA FOR SAFETY. Magnuski, Marilyn J. (Union Carbide Corp., Oak Ridge Tenn. Computing Technology Center). Dec. 3, 1968. Contract W-7405-eng-26. 46p. Dep. CFSTI.

The computer aspects of a growing system of programs written

to facilitate the evaluation of nuclear reactor specifications are analyzed. In the input phase, an MT/ST device is used to create taped card images. These are then used to update a master tape which in turn yields the information needed to write a data cell file. Terminal programs written for the IBM-360 query the file and retrieve various classes of information ranging from very general indicators of the contents of the file to specific information about a particular reactor. Responses to queries are printed out in one of several formats according to the wishes of the user. (auth)

52305 (JPRS-48330) CEMA SYMPOSIUM ON ATOMIC POWER STATIONS WITH FAST REACTORS. VOLUME I. Translation of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Obninsk, 1967. 666p. (CONF-671220-(Vol.1)). CFSTI.

Thirty-one papers are presented in Volume I. A separate abstract was prepared for each of 28 papers. Two papers were previously abstracted in NSA as 22: 32736 and 23: 11269. The paper for which no abstract was prepared contains the introductory remarks. (J.R.D.)

For abstracts of individual papers see: 50021–50024, 50982–50985, 52306–52310, 52335–52338, 52349, 52364, 52370, 52384, 52385, 52396, 52410, 52429–52431, and 52450.

52306 (JPRS-48330, pp 6-11) ROLE OF FAST REACTORS IN ATOMIC POWER ENGINEERING. Leipunskii, A. I. Translated from pp 11-16 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 1, Obninsk, 1967.

Electric power capacity growth rates for the USSR are estimated. The installed power capacity by the year 2000 is expected to be 2,000,000 MW(e), 30 to 50% of which will be nuclear capacity. The reactor fuel situation is examined, and various systems of thermal reactor–fast reactor combinations are examined from the standpoint of uranium resources conservation. (H.D.R.)

52307 (JPRS-48330, pp 12-17) FAST REACTORS IN CZECHOSLOVAK NUCLEAR POWER ENGINEERING AND THE PROGRAM OF JOINT RESEARCH WITH THE USSR. Pashek, M.; Shul'ts, V.; Markvart, Ya.; Truchgorzh, Z. Translated from pp 17-22 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 1, Obninsk, 1967.

The deficit in electricity production capacity after 1980 in Czechoslovakia is estimated. Based on traditional fuel resources and imports, nuclear power stations with a total capacity of 24,000 to 31,000 MW(e) are needed by the year 2000. Approximately 30% of this capacity should come from fast reactor power stations. The economic objectives of the use of fast reactors, the planning needed to construct fast reactors, and the fast reactor research programs necessary for the Czechoslovak power program are discussed. (H.D.R.)

52308 (JPRS-48330, pp 39-108) BASIC QUESTIONS OF THE DYNAMICS OF NUCLEAR SYSTEMS CONTAINING FAST REACTORS. Frankowski, Waclaw. Translated from pp 42-107 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 1, Obninsk, 1967.

A detailed analysis and a comparison of the three basic factors affecting the dynamics of large systems of nuclear power stations are presented. The three factors evaluated are: (1) changes in the Pu isotope concentrations in fast reactor systems; (2) time delays of an operational and technological nature; and (3) discontinuity in the growth function of installed capacity. A model of the dynamics of a two-component nuclear power system based on the evaluation of the above factors is proposed. (H.D.R.)

52309 (JPRS-48330, pp 228-37) THE BOR EXPERIMENTAL REACTOR AND ITS EMPIRICAL BASIS. Leipunskii, A. I.; Blagovolin, S. M.; Baturov, B. B.; (and others). Translated from pp 236-48 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 1, Obninsk, 1967.

The basic characteristics of the BOR-60 sodium-cooled fast breeder are presented. Some results of hydrodynamic tests of fuel assembly and moderator control system hydraulic characteristics are described. Results are also presented for tests on the thermodynamics of the coolant output section. (H.D.R.)

52310 (JPRS-48330, pp 164-87) GAS-COOLED FAST REACTOR WITH HIGH HEAT RELEASE RATE. Feinberg, S. M.; Kovalevich, O. M. Translated from pp 165-92 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 1, Obninsk, 1967.

The feasibility of a gas-cooled fast breeder with a high thermal efficiency and a short doubling time is examined. Fuel element and coolant problems, physics of a Pu-fueled core, heat transfer and structural requirements, and safety problems are briefly analyzed. The analysis indicates that a gas-cooled fast reactor with a doubling time of 3 years is technically and economically feasible. (H.D.R.)

52311 (JPRS-48331, pp 372-406) CALCULATION STUDIES ON THE PHYSICS OF LARGE FAST REACTORS. Novozhilov, A. I.; Troyanov, M. F.; Bobrov, S. B.; Rakitin, I. D.; Zizin, M. N. Translated from pp 319-43 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 2, Obninsk, 1967.

Results of optimization calculations for the core of a 1000 MW(e) sodium-cooled fast reactor are presented. The physics and economic characteristics are examined, and the effects of variations in core composition or configuration are discussed. Data are tabulated on core power characteristics for various enrichments and fuel element loadings based on either oxide or carbide fuel. Safety aspects of the sodium and Doppler reactivity coefficients are discussed. (11 references) (H.D.R.)

52312 (JPRS-48331, pp 438-55) OPTIMIZATION OF FAST REACTORS TAKING THE THERMAL, STRENGTH, AND PHYSICAL CHARACTERISTICS INTO ACCOUNT. Kashutin, A. A.; Kuz'min, A. M.; Silaev, Yu. V.; Khromov, V. V.; Yurova, L. N.; Orlov, V. V.; Pinkhasik, M. S.; Troyanov, M. F.; Likhachev, Yu. I. Translated from pp 379-400 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 2, Obninsk, 1967.

An iteration method for optimization of fast reactor design is examined. The method, based on linear perturbation theory, is used to analyze a dual-purpose fast reactor. The various relations between the thermophysical, structural, and physics parameter restrictions are discussed. (12 references) (H.D.R.)

52313 (JUL-584-RG) PHYSICAL INVESTIGATIONS OF D_2O-MODERATED THORIUM REACTOR. Darvas, J.; Hansen, U.; Teuchert, E. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorentwicklung). Apr. 1969. 88p. (In German). Dep.

The computer programs and calculational procedures used for evaluating kinetic and dynamic characteristics of a heavy water moderated thorium converter reactor are described; a flow diagram shows the computer programs used for specific calculations and indicates their linkages to other programs in the calculational procedure. Design parameters for the conceptual reactor are tabulated. Burnup calculations are described in detail; fission product buildup and breeding rates are evaluated. Effects of core loading, thermal flux and power level on the breeding rate and economics are analyzed. Detailed fuel cycle cost calculations are given; effects of various design parameters are discussed. Breeding potential is evaluated; optimization of the conversion rate is detailed. Control rod effects are considered. A parametric analysis of a typical depletion cycle is detailed. Detailed tables and graphs show all data. (21 references) (M.L.S.)

52314 IMPROVEMENTS IN AND RELATING TO GAS-COOLED NUCLEAR REACTORS. Bennett, John Charles (to Atomic Power Constructions Ltd.). British Patent 1,164,610. Sept. 17, 1969. Filed Jan. 4, 1967.

Reference is made to gas-cooled nuclear reactors having a pressure vessel containing an inverted cup-shaped partition and a graphite moderated core within the partition. Tubes for hot coolant gas extend upwards from fuel channels through a space between the top of the core and the partition. Coolant gas is circulated upwards to the top face of the core, downwards through the moderator and upwards within the fuel channels to exit through hot coolant gas passages. These passages are provided with a number of baffles disposed above and between the core and the upper wall of the partition. The baffles direct coolant gas along a path adjacent to the inner surface of the upper wall. Access is provided in this path to enable coolant gas to reach the moderator. Adjacent baffles are spaced sufficiently to permit relative movement in the direction of the longitudinal axis of the tubes. Various alternative arrangements are also described, and advantages of the system described over systems in use at present are stated. (UK)

52315 ROLE OF PLANNING IN THE ATOMIC ENERGY PROGRAM. Ramey, James T. George Washington Law Rev., 36: 1060-78 (July 1968).

Planning strategy of the U. S. Atomic Energy Commission in developing programs for atomic energy is analyzed. (D.C.C.)

52316 DEVELOPMENT POSSIBILITIES FOR NUCLEAR ENERGY WITHIN THE NEXT 30 YEARS. Schulten, Rudolf.

(Kernforschungsanlage, Juelich, Ger.). VDI (Ver. Deut. Ing.) Z., 111: 563-6(May 1969). (In German).

The international efforts in the development of fast breeder reactors is summarized. Objectives and requirements for future fast breeder developments are discussed. Problems associated with fast breeder and high temperature reactor development are considered. (M.L.S.)

52317 FAST NEUTRON GENERATING STATION PHENIX. Wustner, Remy (CEA, Paris). Ind. At., 13: No. 7-8, 49-58 (1969). (In French).

The history and planning of Rapsodie is summarized; its relation to the Phenix project is discussed. Operations and physics parameters for the two reactors are compared in tabular form. The basic objectives and philosophy behind the Phenix reactor are described. A description of the reactor includes cutaways showing a vertical cross section of the primary system, a cross section of the steam generator with 12 modules, and the reactor with the overall plant. A brief, general description of the site is included. (M.L.S.)

52318 BASIC NUCLEAR ENGINEERING. Foster, Arthur R.; Wright, Robert L. Jr. Boston, Allyn and Bacon, Inc., 1968. 392p. $10.50.

A textbook designed for advanced undergraduate engineering students is presented. Chapters include: Atomic Structure; The Decay of Radioactive Nuclei; Nuclear Reactions; Radiation Detection; Health Physics and Biological Radiation Protection; Radioisotope Applications; Neutron Instructions; The Steady State Reactor Core; Transient Reactor Behavior and Control; Radiation Damage and Reactor Materials Problems; Nuclear Heat Transfer; and Nuclear Reactors. Appendices include: nuclear data for various elements and isotopes, conversion factors, and tables of radioisotopes. (M.L.S.)

52319 SUDOVYE I STATSIONARNYE ZHIDKOMETALLICHESKIE ENERGETICHESKIE USTANOVKI. (Marine and Stationary Liquid Metal Power Installations). Kanaev, A. A.; Kopp, I. Z. Leningrad, Izdatel'stvo Sudostroenie, 1968. 320p.

A brief review is given on the theory, construction, and performance of marine and stationary power installations with liquid and vapor state metal coolants. Problems of thermodynamics, thermal schemes, and construction of auxiliary liquid-metal installations are discussed. Existing concepts and experimental data on the performance of liquid metal power plants, the concepts of heat-exchange and heat-transfer, and hydrodynamics of liquid metal are analyzed. Control and measuring instruments and thermophysical properties of liquid metals are briefly reviewed. 376 references. (tr-auth)

52320 GAS-COOLED FAST REACTOR. Fortescue, Peter; Shanstrom, Raymond T. (to Gulf General Atomic Inc.). U. S. Patent 3,475,272. Oct. 28, 1969. Filed Mar. 28, 1967.

A nuclear power fast gas cooled reactor system is described. The reactor system includes a prestressed concrete containment vessel which contains the entire primary system of the reactor. The interior of the vessel is separated into two regions, the lower one containing the core and having provision for explosion absorption and water flooding. The core is comprised of fuel elements supported in a plurality of elongated tubes in a generally horizontal grid structure. The tubes are secured in the grid structure and mate therewith at their upper ends. (Offic. Gaz.)

52321 SWEDEN'S ENERGY POLICY. OECD (Organ. Econ. Coop. Devel.) Observ., No. 40, 43-5(June 1969).

A review of the nuclear power reactor development program in Sweden is presented. Design parameters for existing power reactors are listed. (BBB)

52322 NUCLEAR ENERGY IN EAST EUROPE. Polach, Jaroslav G. At. Strom, 15: 133-40(July-Aug. 1969). (In German).

The state of development and construction of nuclear power stations in the eastern European countries is reviewed. The future development of nuclear energy in these countries is discussed. (auth)

Kinetics and Dynamics

Refer also to abstracts 50217, 50218, 52411, and 52445.

52323 (JPRS-48331, pp 258-68) REVIEW OF EXPERIMENTAL METHODS DEVELOPED AT SWIERK APPLICABLE TO THE PHYSICS OF FAST REACTORS. Adamski, L.; Dombek, W.; Latek, S.; Chwaszczewski, S.; Jozefowicz, E. Translated from pp 225-35 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 2, Obninsk, 1967.

The state of work done at the Department of Reactor Physics of the Institute of Nuclear Research at Swierk (Poland) by methods which are applicable in the investigation of the parameters of fast reactors is described. In particular, methods and experimental setups are presented for the study of the spectra of fast neutrons, the kinetic parameters of fast reactors, and resonance integrals. (auth)

52324 (JPRS-48331, pp 269-79) STATISTICAL METHODS AS A MEANS OF MONITORING THE TECHNOLOGICAL SAFETY OF POWER REACTORS. Mogil'ner, A. I. Translated from pp 236-44 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 2, Obninsk, 1967.

The application of statistical analysis of reactor noise as a means of operational control is examined. The detection and identification of the various components of noise in power reactors are described. Application of noise analysis methods to detect local boiling and to investigate the characteristics of liquid metal cooled reactors is discussed. (H.D.R.)

52325 (JPRS-48331, pp 280-300) ACCOUNT OF WORK ON THE DOPPLER EFFECT IN FAST REACTORS. Kollatz, Z.; Bohmer, B.; Franke, K.; Pikel'ner, L.; Van'kov, A. Grigor'ev, Yu.; Nikolaev, M.; Filippov, V. Translated from pp 245-58 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 2, Obninsk, 1967.

Experimental evaluation of the Doppler effect by transmittance measurements was obtained with a 20-mm thick uranium filter at a temperature of 850°C. The measurements were carried out in a reactor mode with a spectrometer in a path length of 500 and 1,000 meters. To eliminate any possible instrument instability, the temperature effect was determined by means of multiple measurements with either a hot or a cold specimen. Preliminary results obtained by averaging the transmittance for isolated resonances according to statistical distribution of the neutron widths are presented. (H.D.R.)

52326 (JPRS-48331, pp 456-60) OPTIMIZING THE INITIAL CONVERSION RATIO OF FAST BREEDERS. Purika, I.; Pavelescu, M.; Anton, V. Translated from pp 401-4 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 2, Obninsk, 1967.

Using an algorithm based on game theory, the initial conversion ratio is calculated for a spherical homogeneous fast breeder with ^{238}U and ^{239}Pu fueled breeding and active core zones. (H.D.R.)

52327 (Y-DR-14) HOMOGENEOUS CRITICAL ASSEMBLIES OF 2 AND 3 PERCENT ENRICHED URANIUM IN PARAFFIN. Raffety, S. J.; Mihalczo, J. T. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). May 2, 1969. Contract W-7405-eng-26. 52p. Dep. CFSTI.

A series of clean critical experiments has been performed with homogeneous mixtures of finely divided $U(2)F_4$ or $U(3)F_4$ dispersed in paraffin with $H/^{235}U$ atomic ratios varying from 133 to 972. The assemblies were constructed in rectangular geometry and minimum critical masses and volumes in cylindrical and spherical geometries were obtained from buckling conversions. The minimum critical spherical volumes of a $U(2)F_4$-paraffin mixture when unreflected and reflected with an effectively infinite hydrogenous reflector are 199 and 138 liters, respectively, and the minimum critical ^{235}U masses are 7.5 and 5.4 kg, respectively. Cadmium ratios at the center of the critical assemblies have been measured for gold, In-Al alloy, 10 wt % U(93)-Al alloy and U(93) metal foils. Transport theory calculations of k_∞ and k_{eff} have been made using various cross section sets. The results indicate that the resonance absorption cross sections for ^{238}U may be too large. 19 references. (auth)

Control Systems

Refer also to abstract 51144.

52328 (ANL-EBR-1) EBR-II: DIGITAL DATA ACQUISITION SYSTEM STUDY. Hyndman, R. W.; Haroldsen, R. O.; Karvinen, J. R. (Argonne National Lab., Ill. Argonne National Lab., Idaho Falls, Idaho). May 1969. Contract W-31-109-eng-38. 33p. Dep. CFSTI.

The Digital Data Acquisition System (DAS) for use with the EBR-2 is described. The system will display to the operators computed results for control and information. It also provides data storage. Functional requirements and necessary equipment are described. (auth)

52329 (BAW-3647-13) PHYSICS VERIFICATION PROGRAM, PART III, TASK 1. Final Report. Baldwin, M. N.; Stern, M. E. (Babcock and Wilcox Co., Lynchburg, Va. Research and Development Div.). July 1969. Contract AT(30-1)-3647. 47p. Dep. CFSTI.

The response of an all-solid self-powered in-core neutron flux detector was measured at temperatures approaching those of an operating power reactor. Measurements were made in a water environment and in a subcritical fueled lattice environment over a wide range of moderator boron concentrations. The results obtained are summarized. (H.D.R.)

52330 (JPRS-48331, pp 301-42) BASIC PRINCIPLES FOR SELECTING REGULATING ORGANS FOR FAST POWER REACTORS. TEMPERATURE AND POWER EFFECTS IN FAST REACTORS. Orlov, V. V.; Matveev, V. I.; Zhukov, A. V.; Ivanov, A. P.; Pshakin, G. M. Translated from pp 259-93 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 2, Obninsk, 1967.

The problems of selecting the most effective methods of controlling large fast reactors are considered, and various absorption materials and the prospects of using them in control devices are discussed. The components of the temperature and power effects in fast reactors are analyzed and considerations on methods of calculating them are presented. (auth)

52331 NUCLEAR REACTOR AND METHOD OF OPERATING SAME. Boettcher, Alfred (to Kernforschungsanlage des Landes Nordrhein-Westfalen-e.V.). U. S. Patent 3,464,888. Priority date Jan. 21, 1965, Germany.

A method is described of operating a heterogeneous nuclear reactor in which carbide- or carbon-coated particles of a nuclear-fuel and/or downward through vertical channels in a graphite reactor core at a rate of 2 to 20 mm/hr. The reactor is controlled by the rate of withdrawal of the particles from the base of the channels. The channels have cross-sectional dimensions substantially in excess of the dimensions of the particles, namely, 0.2 to 2 mm. A coolant is passed through ducts in the reactor core independent of the channels while helium fills the channels to serve as a heat-transfer promoter between the particles in the channels and the channel walls. The fuel particles are fed to the channels selectively in accordance with the degree of burnup. (Offic. Gaz.)

Shielding

Refer also to abstract 51124.

52332 (INR-959) ANALOG STUDY OF TEMPERATURE DISTRIBUTIONS IN REACTOR SHIELDS WITH INNER COOLING PIPES. Strupczewski, A. (Institute of Nuclear Research, Warsaw (Poland)). 1968. 44p. Dep. CFSTI (U. S. Sales Only).

The temperature distributions in the reactor thermal shields with inner cooling pipes found with the use of Resistance Analog Computer RAC for a wide range of shield geometries are presented. The results are given as functions of dimensionless geometrical parameters of the shield, and the range of utilization of obtained curves is widened by introducing a "dimensionless temperature distribution function" $\Delta TK\mu^2/q_0'''$ making it possible to define the temperature field for any values of the thermal conductivity K, heat generation q_0''' and radiation energy absorption coefficient μ. (auth)

52333 (JPRS-48331, pp 343-71) CHARACTERISTICS OF THE PLANNING OF BIOLOGICAL AND ACTIVATION SHIELDING FOR FAST REACTORS. Kulakovskii, M. Ya. Translated from pp 294-318 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 2, Obninsk, 1967.

Shielding considerations for sodium-cooled fast reactors are examined. Shielding computation methods are briefly described, and properties of some shielding materials are presented. Measured and calculated neutron attenuation data are tabulated for fast reactor shielding and structural materials. 15 references. (H.D.R.)

Cooling Systems

Refer also to abstracts 49993, 50220, and 52431.

52334 (EURAEC-2104) INVESTIGATIONS ON CYCLONES FOR STEAM SEPARATION IN BOILING WATER REACTORS. 11th Quarterly Report, July 1-September 30, 1967. (Allgemeine Elektricitaets-Gesellschaft, Frankfurt am Main (West Germany). Kernenergieanlagen). Oct. 17, 1968. Contract No. 083-66-1-TEED. 59p. (EUR-4015). Dep. CFSTI.

The development of a downflow cyclone type steam separator for use in large BWR with direct cycle is described. The measurements made on nine different cyclones for the optimization of several dimensions of the single cyclone are presented. (auth)

52335 (JPRS-48330, pp 188-227) FAST BREEDER REACTORS DIRECTLY COOLED BY A BOILING HEAT TRANSFER FLUID. Taube, Mieczyslaw. Translated from pp 193-235 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 1, Obninsk, 1967.

A classification scheme for fast reactors is presented. The classification is based on the phase state of the fuel and on the heat transfer process. Fast breeder concepts fueled with fused chlorides of U, Pu, and Na or K and cooled by a boiling fluid are discussed. The homogeneous $AlCl_3^-$ cooled SAWA and the heterogeneous boiling Hg-cooled WARS reactors are described. Some parameters for 1000 MW reactors of the SAWA and WARS type are calculat-d. Safety requirements and the boiling mechanism problems are discussed. The fuel regeneration procedures are described. (H.D.R.)

52336 (JPRS-48330, pp 293-312) SYSTEM OF MONITORING AND MEASURING INSTRUMENTS FOR FAST REACTORS. Mitropol'skii, A. N.; Petrenko, A. A.; Pinkhasik, M. S.; Taranin, V. D.; Tsukerman, I. Kh.; Zvenigorodskii, E. G.; Kozlov, M. G.; Klepikov, V. P. Translated from pp 312-33 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 1, Obninsk, 1967.

The functions of components and subsystems of fast reactor control systems are examined. Aspects of the operation of the overall control system are discussed, and characteristics of the principal devices for sodium monitoring and control are described. Specific components and systems for oxide monitoring, electric heating of the sodium circuits, and temperature, pressure, flow, and level measurements are described in detail. (H.D.R.)

52337 (JPRS-48330, pp 396-425) SOME PROBLEMS OF BOILING AND OUTGASSING IN SODIUM. Subbotin, V. I.; Arnol'dov, M. N.; Ivanovskii, M. N.; Kudryavtsev, A. P.; Ovechkin, D. M.; Sorokin, D. N.; Shmatko, B. A. Translated from pp 422-50 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 1, Obninsk, 1967.

Comparative evaluations are made of the conditions for vapor bubble nucleation and growth in Na and water. Experimental data are analyzed on heat exchange and critical heat flux during sodium boiling under conditions of free convection. Conditions for outgassing of impurities from sodium are considered. (H.D.R.)

52338 (JPRS-48330, pp 640-66) PROSPECTS FOR USING CHEMICALLY REACTING SYSTEMS AS COOLANT AND WORKING SUBSTANCE IN ATOMIC POWER STATIONS WITH FAST NUCLEAR REACTORS. Krasin, A. K.; Nesterenko, V. B.; Tverkovkin, B. E.; Bubnov, V. P.; Naumov, V. A. Translated from pp 639-59 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 1, Obninsk, 1967.

The technical and economic conditions limiting the efficiency of sodium-cooled fast reactors and of conventional steam turbine plants are reviewed. The prospects for increasing the thermodynamic efficiency of the plants and the unit capacity of single-shaft turbine sets by the use of various coolants and working substances are examined. Advantages of using dissociating systems in a closed gas turbine cycle are discussed. The dissociating systems consist of gases in which, with successive heating and cooling, reversible chemical reactions take place, accompanied by an increase in mole number on heating and by a decrease in mole number on cooling. The thermodynamic cycle efficiency of gas turbine plants using dissociating coolants N_2O_4 and Al_2Cl_6 are compared to plants using steam turbines. The calculations indicate an increase in nuclear power plant efficiency to 50-52% is possible using these gases. (H.D.R.)

52339 (JPRS-48331, pp 601-50) HEAT EXCHANGE AND HYDRODYNAMICS IN FAST REACTORS. Subbotin, V. I.; Ushakov, P. A.; Zhukov, A. V.; Sheynina, A. V. Translated from pp 529-68 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 2, Obninsk, 1967.

Results of studies on the thermodynamics and hydrodynamics of fast reactor cores are presented. Equations describing laminar flow and turbulent flow of coolant are examined, and calculated and experimental data are compared. Heat transfer by fuel element assemblies of the BR-60 reactor concept is investigated by core assembly models. Equations are described and calculated

data are presented for temperature distributions in central, side, and corner fuel elements, coolant temperature distribution in the assembly cross section, fuel element mean surface temperature, and heat release rate variations along the length of fuel rods. (H.D.R.)

52340 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. (to Gulf General Atomic Inc.). British Patent 1,166,569. Oct. 8, 1969. Priority date Sept. 6, 1966, United States.

HEAT TRANSFER SYSTEMS—design of prestressed concrete enclosed, for gas cooled fast power reactor
REACTORS, FAST—cooling system of gas cooled power, description of prestressed concrete enclosed
REACTORS, GAS-COOLED—cooling system of fast power, description of prestressed concrete enclosed
REACTORS, POWER—cooling system of gas cooled fast, description of prestressed concrete enclosed (D.C.C.)

52341 CONNECTING ARRANGEMENT FOR TUBULAR FUEL ELEMENTS OF A BOILING WATER SUPERHEATER REACTOR. (to Licentia Patent-Verwaltungs-GmbH). British Patent 1,165,718. Oct. 1, 1969. Priority date Dec. 9, 1965, Germany.

HEAT TRANSFER SYSTEM—fuel tubes for external boiling and internal superheat reactor, description of parallel and series connected
REACTORS, SUPERHEATING—cooling system for description of parallel and series connected fuel tubes for external boiling and internal superheat (D.C.C.)

52342 REDUCING THE CORROSION OF GRAPHITE IN NUCLEAR REACTORS. Pointud, Marie-Louise; Ranc, Rene; Richardot, Jean-Pierre (to Commissariat a l'Energie Atomique). British Patent 1,166,001. Oct. 1, 1969. Priority date Nov. 7, 1967, France.

CARBON DIOXIDES—corrosive effects on graphite, effects of additives on
GRAPHITE—corrosion by carbon dioxide, effects of additives on
REACTORS, GAS-COOLED—corrosion of graphite moderator in carbon dioxide, effects of coolant additives on
REACTORS, GRAPHITE-MODERATED—corrosion of moderator in carbon dioxide cooled, effects of coolant additives on (D.C.C.)

52343 DEPOSITION OF IODINE ON LOW CHROMIUM ALLOY STEEL. Milstead, C. E.; Bell, W. E.; Norman, J. H. (Gulf General Atomic Inc., San Diego, Calif.). Nucl. Appl. Technol., 7: 361-6(Oct. 1969).

The deposition of iodine on low chromium alloy steel (1% Cr–¼% Mo alloy) has been investigated in vacuo at 316°, 400°, and 482°C using a pseudoisopiestic (static) method. An adsorption isotherm was obtained at 400°C over an iodine (monatomic) pressure range of 2.9×10^{-9} to 5.1×10^{-7} atm. The levels of iodine deposition at 400°C ranged from 3.8 to 23.2 μg I/cm^2; these values are in agreement with data obtained using transpiration techniques. The low level sorption data are interpreted on the basis of the dissociation of I_2 to yield monatomic iodine as well as the interaction with the steel surface to form volatile iron iodides, which were deposited in cooler regions of the apparatus. The high level sorption behavior of iodine on steel is in accord with the expected behavior based on the thermodynamic properties of $FeI_2(s)$. (auth)

52344 SODIUM-LOOP PROBLEMS IN FAST-NEUTRON REACTORS. Schwarz, K. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie, 12: 257-64(Aug. 1969). (In German).

Problems and hazards involved with liquid Na coolant in liquid metal-cooled fast reactors are analyzed. Typical reactor coolant loop layouts are presented. 28 references. (auth)

52345 CRITICAL HEAT FLUX MEASUREMENTS IN A 16-ROD SIMULATION OF A BWR FUEL ASSEMBLY. Israel, S. (United Nuclear Corp., Elmsford, N. Y.); Casterline, J.; Matzner, B. J. Heat Transfer, 91: 355-63(Aug. 1969).

Critical heat flux data were obtained for forced flow boiling in a 16-rod test section arranged in a square array. The tests were performed at 1000 psia and used a radial power distribution which represented the region about the hot corner in a BWR fuel assembly. The results are lower than data obtained in a 9-rod square array, having a uniform power distribution, based on the average bundle exit quality. These two sets of data are in fair agreement when compared on the basis of the highest subchannel exit quality. Comparisons of different sets of data show the effects of different rod spacers and bundle misalignment on the critical heat flux. (auth)

52346 NUCLEAR REACTOR HAVING A CONCRETE PRESSURE VESSEL. Livsey, Walter Oldham; Young, Alexander Gillies (to English Electric Co., Ltd.). U. S. Patent 3,470,066. Priority date June 18, 1965, Great Britain.

A concrete combined pressure vessel/biological shield for a nuclear reactor comprises a single wall with a cylindrical vertical outer surface and has vertical cylindrical penetrations in said wall, in each of which there are closely fitted a boiler and a coolant circulator coaxial with the boiler. (Offic. Gaz.)

Fuels

52347 (ANL–6549) FLOW CHARACTERISTICS OF THE EBR-II CORE-TYPE SUBASSEMBLY. Bump, T. R.; Monson, H. O. (Argonne National Lab., Ill.). Apr. 1962. Contract W-31-109-eng-38. 43p. Dep. CFSTI.

To assist in the determination of the relationship between power level and fuel temperatures in the Experimental Breeder Reactor II (EBR-II) fuel subassemblies, local coolant velocity measurements were made in a model subassembly almost three times the linear size of the prototype. These measurements indicate that the fuel-element spiral-spacer wires exert considerable influence on the velocities. Static-pressure measurements were also made on the model subassembly, to provide information concerning (the pressure drop across the fuel-element bundle alone, and the effect of spiral spacer wires on pressure drop. 15 references. (auth)

52348 (ANL–EBR–2) POSTIRRADIATION INSPECTION OF SUBASSEMBLIES DISCHARGED FROM RUNS 25 AND 26 IN EBR-II. Smith, R. R.; Mitchell, D. L. (Argonne National Lab., Ill. Argonne National Lab., Idaho Falls, Idaho). Mar. 1969. 40p. Dep. CFSTI.

The effects of bowing forces generated by stainless steel reflector subassemblies on driver subassemblies were investigated by making a series of dimensional checks on driver subassemblies discharged at the ends of Runs 25 and 26 in EBR-II. Postirradiation measurements were made of straightness, twist, and changes in dimensions across the spacer pads of opposite flats of the hexagonal tube of the driver subassemblies. The results of measurements of subassemblies discharged from Run 25 indicated no perceptible change in straightness or twist. The results of dimensional checks across the spacer pads of opposite flats, however, indicated an average decrease of 0.001 in. per set of flats. Straightness and twist tests were not made of subassemblies discharged from Run 26. The results of dimensional checks across the spacer pads of opposite flats of these subassemblies indicated a net decrease of 0.001 in. per set of flats. 3 references. (auth)

52349 (JPRS–48330, pp 109-22) NUCLEAR FUEL BALANCES AND THE PROBLEMS GENERATING FROM THEM. Rokshtro, R.; Kollats, Z. Translated from pp 108-20 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 1, Obninsk, 1967.

Equations for calculating the basic initial characteristics of nuclear power systems containing fast reactors are presented. Two different types of systems containing fast reactors are examined. Results are presented and evaluated for calculations of the total U requirements, chemical reprocessing requirements, and a definition of new fuel element needs. (H.D.R.)

52350 (JPRS–48331, pp 462-80) PROBLEMS OF DEVELOPING FUEL ELEMENTS FOR FAST NEUTRON REACTORS. Golovnin, I. S.; Agapova, N. P.; Pinkhasik, M. S.; Men'shikova, T. S.; Ioltukhovskii, A. G.; Sokolov, D. D.; Bibilashvili, Yu. K.; Sytov, L. I.; Zakharko, Yu. A. Translated from pp 407-24 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 2, Obninsk, 1967.

The prototype fast reactors operating or under construction are reviewed with respect to their fuel element requirements. Problems in regard to fuel and jacket material compatibility with each other and with the coolant are examined. The choice of jacket alloys for the various operating conditions is discussed. Advantages and disadvantages of using metallic or ceramic fuels are described, and the various fuel element designs are studied. *39 references.* (H.D.R.)

52351 (JPRS–48331, pp 481-94) *OXIDE FUEL FOR FAST* REACTORS. Kazachkovskii, O. D.; Lebedev, I. G.; Golovnin, I. S.; Kuz'min, V. I.; Sytov, L. I.; Bibilashvili, Yu. K.; Vyskubov, V. P.; Piskun, A. S.; Filatkina, V. P.; Rodin, V. M. Translated from pp 425-38 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po

Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 2, Obninsk, 1967.

The results of testing and investigating oxide fuels and fuel elements for a maximum burnup of up to nine percent of the heavy atoms are reported. Compositions of UO_2, PuO_2, and mixtures of UO_2-PuO_2 with a PuO_2 content of 14 and 20 percent were investigated. Stainless steels were used in cladding the experimental fuel elements. Investigations were carried out with the fuel elements for the BR-5 (FR-5) reactor at a maximum burnup of 5.3 percent, for 12 capsule samples of mixed oxides with a burnup of 5.5 percent, and for 7 UO_2 capsule specimens with a burnup of 9.2 percent. Irradiation was carried out in the SM-2 reactor, employing an intermediate spectrum of neutrons. (auth)

52352 (JPRS-48331, pp 576-600) STRESS-RUPTURE STRENGTH AND CREEP OF FUEL-ELEMENT JACKETS FOR FAST REACTORS. Likhachev, Yu. I.; Vakhromeeva, V. V. Translated from pp 510-28 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 2, Obninsk, 1967.

A method is proposed for calculating the stress-rupture strength and creep of jackets of hermetic cylindrical fuel elements of fast reactors, taking into account the kinetics of the stressed and deformed state of the jacket and the accumulation of damages by the jacket material during the time of operation of the apparatus. The efficiency of the jacket is determined by the coefficient of reserve strength with regard to stresses and by the amount of deformation of the jacket accumulated during its lifetime. Calculations are carried out for a hermetic fuel element of a fast reactor with a jacket of austenitic steel and UO_2 fuel in the form of sintered hollow pellets. (auth)

52353 (RD/B/N-1428) FISSION PRODUCT INVENTORIES. PART II. RESULTS FOR MAGNOX, AGR, HTR, AND CFR REACTORS USING FISP. Clarke, R. H.; Utting, R. E. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). July 1969. 50p. Dep. CFSTI (U. S. Sales Only).

The program FISP was used to obtain fission product inventories for Magnox, AGR, HTR, and CFR reactors. The use of the program for these specific applications is described in detail, so that the integrity of the results may be judged together with the effects of changes in basic data. Examples of complete inventories, given for illustration, were chosen for their general usefulness in a wide range of problems. They are representative of the more highly irradiated fuels from the four reactor types, and the basic burnup parameters are: Magnox 7,000 MWD/te at 5 MW/te; AGR 25,000 MWD/te at 20 MW/te; HTR 60,000 MWD/te at 50 MW/te; and CFR 100,000 MWD/te at 300 MW/te. (auth) (UK)

52354 (UJV-2238-R) HYDRODYNAMIC AND THERMOKINETIC CHARACTERISTICS OF MOCK-UP SEVEN-CHANNEL FUEL RODS. Paryzek, R.; Pasek, M. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). [1969]. 25p. (In Czech). Dep. CFSTI (U. S. Sales Only).

The method for calculating the hydrodynamical stability of an experimental mock-up EK-7 of a seven-rod fuel element is analyzed. The step of the heating rod mock-up is $s = 1.2$ d. The rod diameter $d = 14$ mm. Two margin rods are rotating around their axis and the central one may be deflected in the direction of the connecting line of two opposite margin rods by $\pm$ the gap between the rods. 4 references. (auth)

52355 IMPROVEMENTS IN AND RELATING TO WATER-COOLED NUCLEAR REACTORS. Wadmark, Lars Olof Tor (to Aktiebolaget Atomenergi). British Patent 1,165,689. Oct. 1, 1969. Priority date Dec. 3, 1965, Sweden.

REACTOR LOADING MACHINES—tube connected, for water cooled reactors
REACTORS, WATER-COOLED—loading machine for, description of tube connected (D.C.C.)

52356 VANADIUM ALLOYS VS STAINLESS STEEL FOR SODIUM-COOLED FAST REACTOR CLADDING. Edison, G.; Whitlow, G. A. (Westinghouse Electric Corp., Madison, Pa.). Nucl. Appl. Technol., 7: 443-55(Nov. 1969).

The development of V alloys for fuel element cladding in Na-cooled fast breeder reactors is reviewed. A survey of the "state of the art" for this application is included. Alloy composition and fabrication are discussed. Candidate alloys are compared with stainless steel with respect to physical and mechanical properties and compatibility with Na and ceramic fuels. Limited data on irradiation damage are presented. Results of an evaluation of the performance and economic potential of V alloy cladding in a carbide-fueled LMFBR are presented. A comparison is made with Type 316 stainless steel. Fuel cycle costs are presented as well as important nuclear safety characteristics such as Doppler and Na void reactivity coefficients. The results are presented for a range of cladding thicknesses, tubing costs, and reactor coolant outlet temperatures. 40 references. (auth)

52357 THORIUM CYCLE BREEDERS REACTORS. van Dam, H. (Delft Technical Univ., Netherlands); Went, J. J. Atompraxis, 15: 173-7(May-June 1969).

Advantages and disadvantages of Th breeder reactors are outlined. The role of the thermal breeder is evaluated with respect to its role in other reactor programs. Programs of suggested reactor strategies are tabulated. Fast and intermediate ^{239}Pu- and ^{233}U-fueled reactors are compared; data are shown graphically. Fissile inventories and doubling times of ^{239}Pu- and ^{233}U-fueled fast reactors are tabulated. (M.L.S.)

52358 TECHNICAL AND ECONOMIC ANALYSIS OF VARIOUS FUEL CYCLES IN A CIRENE TYPE REACTOR. Cardosi, G.; Mazzanti, A.; Venditti, P. Ing. Nucl., 10: No 2, 47-53(Mar.-Apr. 1969). (In Italian).

A description of the CIRENE-type reactor is outlined. Methods for evaluating the fuel cycle economics of these reactors are tabulated. Results of technical-economic evaluations of fuel cycles are tabulated for once-through natural uranium, once-through enriched U, U-Pu, and U-Th. Conversion ratios are shown as a function of length of irradiation. Effects of initial enrichment are considered. 11 references. (M.L.S.)

52359 NUCLEAR FUEL ELEMENTS. Gauthron, Maurice (to Commissariat a l'Energie Atomique). British Patent 1,168,054. Oct. 22, 1969. Priority date July 10, 1967, France.

REACTOR FUEL ELEMENTS—design of fission gas vented, for liquid sodium cooled reactors
REACTORS, LIQUID METAL-COOLED—fuel elements of, design parameters of fission gas vented (D.C.C.)

52360 IMPROVEMENTS IN OR RELATING TO FUEL ELEMENTS. Darras, Raymond; Dewanckel, Bernard; Leclercq, Daniel (to Commissariat a l'Energie Atomique). British Patent 1,168,254. Oct. 22, 1969. Priority date Jan. 20, 1966, France.

BERYLLIUM ALLOYS AND SYSTEMS—Be-Cu, corrosive effects of carbon dioxide on reactor fuel element cladding of
COPPER ALLOYS AND SYSTEMS—Be-Cu, corrosive effects of carbon dioxide on reactor fuel element cladding of
REACTOR FUEL ELEMENTS—cladding for carbon dioxide cooled, oxidation of beryllium-copper alloy
REACTORS, GAS COOLED—fuel element cladding for carbon dioxide, oxidation of beryllium-copper alloy (D.C.C.)

Auxiliary and Emergency Systems

52361 (ANL-EBR-3) EBR-II PRIMARY SODIUM-STORAGE FACILITY. Crothers, C. C. (Argonne National Lab., Ill. Argonne National Lab., Idaho Falls, Idaho). Feb. 1969. Contract W-31-109-eng-38. 17p. Dep. CFSTI.

A primary-Na-storage facility designed for the EBR-2 is described. The facility provides the capability of removing Na from the EBR-2 primary tank. The facility has a 90,000 gallon capacity, an Ar-cover-gas and vacuum system, an electrical heating system, instrumentation, and a 25 gpm Na pump. 2 references. (D.C.C.)

52362 (APED-5654) CONSIDERATIONS PERTAINING TO CONTAINMENT INERTING. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Aug. 15, 1968. 104p.

Since the issuance of a construction permit for Dresden Unit 2, provisions have been made for inerting the pressure suppression containment if required. This requirement originated from early consideration which demanded that the containment be designed to withstand, without exceeding the design pressure, a substantial metal-water reaction resulting from an assumed reactor core meltdown. Since that time, major improvements have been made in the provision for core standby cooling. The pressure suppression containment without an inert gas can be shown to have a substantial margin with respect to remaining within its pressure rating for the worst expected metal-water reaction, whether the hydrogen burns in the containment or not. Technical studies on the position that containment inerting should not be a requirement for pressure suppression systems are presented. 15 references. (auth)

52363 (GEAP-5701) FUEL HANDLING AND OTHER TESTS IN THE SEFOR REFUELING CELL MOCKUP. Steamer, A. G.; Brynsvold, G. V.; Franckx, L. C. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Development Operation). Mar. 1969. Contract AT(04-3)-540. 76p. Dep. CFSTI.

A full-scale mockup of the SEFOR refueling cell was constructed to test the fuel handling operations under typical operating conditions. Initial equipment tests were performed with air in the refueling cell to determine optimum equipment locations and viewing facilities, and to check equipment operation. The cell was next filled with argon and the mockup reactor vessel and Na service system were filled with Na, which simulated all but the nuclear environment typical of reactor operation. Tests were then performed to check the performance of the argon purification system, fuel handling operations, Na sampling, reactor head removal and replacement, and Na vapor deposition in the cell. (auth)

52364 (JPRS-48330, pp 325-54) EMERGENCY SHUTDOWN COOLING OF LIQUID-METAL COOLED FAST REACTORS. Rineiskii, A. A.; Pinkhasik, M. S.; Pyshin, V. K. Translated from pp 348-80 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 1, Obninsk, 1967.

Data on emergency shutdown cooling of fast reactors in operation, being constructed, in planning, or decommissioned are tabulated and discussed. The problem of heat removal from the secondary circuit is examined. Methods for numerical approximation of the most widely used types of differential equations for computing transient processes of emergency cooling are presented. Analytical expressions for calculating pump rundown and temperature in the mixing chamber are defined. (H.D.R.)

52365 NUCLEAR REACTORS. (to Stone and Webster Engineering Corp.). British Patent 1,166,004. Oct. 1, 1969. Priority date Mar. 21, 1967, United States.

REACTOR CONTAINMENT STRUCTURES—pressure suppressing double wall hemispherical dome, for pressurized water reactors

REACTORS, PRESSURIZED-WATER—containment structures for, description of pressure suppressing double wall hemispherical dome (D.C.C.)

52366 FUEL HANDLING SYSTEM FOR CORE ELEMENTS OF A PEBBLE BED REACTOR. Hennings, U. (Brown Boveri/Krupp, Mannheim, Ger.). Nucl. Appl. Technol., 7: 334-41(Oct. 1969).

The AVR pebble bed reactor contains about 90,000 spherical fuel elements loosely piled in the core cavity within the reflector graphite structure. Gravity is utilized for fuel sphere removal from the core and pneumatic energy is used for loading or recirculating the elements. The only core handling equipment are pipes connected at appropriate points, and all installations to initiate the desired sphere movement are located in an external system. Design requirements for the fuel handling system are listed. Some of the unique features of the system are described, and some of the operating experience with the system is presented. (H.D.R.)

Operation and Economics

52367 (BAW-1328(Vol.1)) 1000-MWe LMFBR FOLLOW-ON STUDY. TASK II AND III FINAL REPORT. VOLUME 1. SUMMARY DESCRIPTION AND COST ESTIMATE. (Babcock and Wilcox Co., Lynchburg, Va. Power Generation Div.). Feb. 1969. Contract 31-109-38-1998. 202p. Dep. CFSTI.

For Argonne National Lab., Ill.

Design parameters for the conceptual 1000 MW(e) LMFBR are presented. Buildings and facilities are described. Costs analyses for the reactor operation and maintenance are presented. 10 references. (D.C.C.)

52368 (DOCKET-50146-42) [SAXTON REACTOR]. Operations Report, August 1969. (Saxton Nuclear Experimental Corp., Pa.). 7p. Dep. CFSTI.

52369 (GEAP-5678) CONCEPTUAL PLANT DESIGN, SYSTEM DESCRIPTIONS, AND COSTS FOR A 1000 MWe SODIUM COOLED FAST REACTOR. TASK II REPORT OF 1000 MWe LMFBR FOLLOW-ON WORK. Gee, W. R. Jr. (comp.) (General Electric Co., Sunnyvale, Calif. Advanced Products Operation). Dec. 1968. Contract 31-109-38-1997. 298p. Dep. CFSTI.

For Argonne National Lab., Ill.

The reference concept is described and systems and components designs are presented. Capital costs, fuel cycle costs, and operating and maintenance costs are estimated. (H.D.R.)

52370 (JPRS-48330, pp 18-38) STUDY OF ATOMIC POWER STATION SYSTEMS FROM THE VIEWPOINT OF COMPLETE UTILIZATION OF NUCLEAR FUEL RESERVES. D'yula, Chom. Translated from pp 23-41 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 1, Obninsk, 1967.

Power reactor systems are examined from the standpoint of their efficiency of fuel use. Combined systems of both thermal reactors and fast reactors and fast reactor only systems are evaluated and compared. It is concluded that economic utilization of fuel reserves is possible in either system or in some intermediate combination of them. (H.D.R.)

52371 (JPRS-48331, pp 426-37) ON THE QUESTION OF EFFICIENCY CRITERIA OF FAST NEUTRON ATOMIC POWER STATIONS. Kazachkovskii, O. D.; Kirillov, E. V. Translated from pp 365-78 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 2, Obninsk, 1967.

The development of atomic power engineering requires optimization of the technological and economic designs of atomic power stations. The following values are used for fast reactors: breeding ratio, thermal efficiency, fuel doubling time, and electric energy costs. The role and significance of the above factors in the study of economic effectiveness of fast reactors are discussed. 4 references. (auth)

52372 (LA-4272) ULTRA HIGH TEMPERATURE REACTOR EXPERIMENT (UHTREX). Quarterly Status Report for Period Ending July 31, 1969. (Los Alamos Scientific Lab., N. Mex.). Sept. 26, 1969. Contract W-7405-eng-36. 16p. Dep. CFSTI.

Operations and testing programs in the Los Alamos Turret Reactor during May to July 1969 are described. 2 references. (D.C.C.)

52373 THE NEW FUTURE OF THE FRENCH NUCLEAR PROGRAM. Evora, Jean. Sci. Avenir, No. 265, 206-13(Mar. 1969). (In French).

The entry of nuclear power into the economy of France is described. Problems and proposed development areas are analyzed. (BBB)

Safety and Siting

Refer also to abstracts 50565 and 51037.

52374 (AI-AEC-Memo-12761(Rev.1)) AN EVALUATION OF THE BEHAVIOR OF AEROSOLS PRODUCED BY THE LMFBR DBA. Koontz, R. L.; Morewitz, H. A. (Atomics International, Canoga Park, Calif.). May 15, 1969. Contract AT(04-3)-701. 16p. Dep. CFSTI.

The existing experimental data on UO_2 and PuO_2 aerosols are evaluated and an empirical model of the behavior of aerosols produced in the primary containment by the LMFBR DBA is developed. This model is based on the well known "stirred settling" law for aerosols. The specific reduction factor for the aerosol concentration in the primary containment for any given plant due to agglomeration and subsequent fallout is estimated. 8 references. (auth)

52375 (AI-AEC-12816) LMFBR SAFETY PROGRAMS. Quarterly Technical Progress Report, January-March 1969. (Atomics International, Canoga Park, Calif.). May 31, 1969. Contract AT(04-3)-701. 18p. Dep. CFSTI.

AEROSOLS—characteristics from liquid sodium spray fires under simulated reactor coolant loss accident conditions (E)

REACTORS, LIQUID METAL COOLED—coolant loss accidents in sodium cooled, spray fire aerosol characteristics from (E)

SODIUM—fires from escaping reactor coolant liquid, release and transport of effluents and energy during spray (E)

—burning rate in fires in large pools of liquid, effects of oxygen concentration on (E/T)

—fires in large pools of liquid, energy release from and thermal behavior of (E/T)

SODIUM OXIDES—aerosol release from large liquid sodium pool fires, airborne concentration and deposition following (E/T)

URANIUM OXIDES U_3O_8—aerosol characteristics at low concentrations (E) (H.D.R.)

52376 (AI-AEC-12837) THE EFFECT OF AEROSOL AGGLOMERATION ON THE REDUCTION OF THE RADIOLOGICAL SOURCE TERM FOR THE LMFBR DESIGN BASIS ACCIDENT. Koontz, R. L.; Hubner, R. S.; Greenfield, M. A. (Atomics International, Canoga Park, Calif.). Sept. 15, 1969. Contract AT(04-3)-701. 93p. Dep. CFSTI.

Calculations of the stirred settling rate of particles with heterogeneous distributions characterized as log normal are presented.

The data are presented in a form which allows one to estimate the fractional decrease of the initial concentration versus time for a given distribution. A log-normal distribution is completely characterized by the median size and geometric standard deviation. Additional data are presented which allows one to determine the leaked fraction of the mass which is released into a vessel as a function of time for a given distribution. Finally, an empirical relation is suggested for estimating the median particle size produced by agglomeration of initial particles as a function of the mass introduced into the test chamber. The settling velocities are computed on the base of Stokes Law. 19 references. (auth)

52377 (BMI–1865) FISSION-PRODUCT DEPOSITION AND ITS ENHANCEMENT UNDER REACTOR ACCIDENT CONDITIONS: DEPOSITION ON CONTAINMENT-SYSTEM SURFACES. One of Three Separate Final Reports on Task 3. Rosenberg, Harvey S.; Genco, Joseph M.; Morrison, David L. (Battelle Memorial Inst., Columbus, Ohio). May 1969. Contract W-7405-eng-92. 116p. (EURAEC–2119). Dep. CFSTI.

Work performed under United States–Euratom Joint Research and Development Program.

Iodine deposition on stainless steel surfaces and on commercial paints used within the nuclear power industry has been studied as related to fission-product behavior in the containment vessel during a loss-of-coolant accident in a water-cooled reactor. Sorption-desorption experiments were performed with I_2 from both the vapor and aqueous phases as well as under condensing steam conditions. Vapor-phase kinetic studies were performed in steam-air mixtures from 25 to 170°C while aqueous-phase studies were conducted between 25 and 90°C using saturated solutions. 26 references. (auth)

52378 (BNWL–1187) NUCLEAR SAFETY QUARTERLY REPORT, MAY–JULY 1969. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Sept. 1969. Contract AT(45-1)-1830. 134p. Dep. CFSTI.

ACOUSTIC EMISSION TESTING—use for pipe failure detection, development of system for
AEROSOLS—transport to vertical surfaces by condensing steam
CALCINATION—spray equipment and procedures development for radioactive waste solution solidification
CONTAINMENT SYSTEMS EXPERIMENT—spray system for fission product aerosol removal, effectiveness of
—pressure suppression by water sprays in
—blowdown tests in, pressure and temperature transients during
—core support plate in, transient blowdown pressures on
FISSION PRODUCTS—removal from reactor containment, effectiveness of spray system for
GLASS—production of phosphate, for fixation of radioactive wastes
NEUTRONS, FAST—effects on tensile properties of HSST steel
PIPES—crack detection in pressure, acoustic emission method for
RADIOACTIVE WASTE—fixation by conversion to phosphate glass, evaluation of test runs for
—solidification of solutions of, spray calciner development for
REACTOR SAFETY—containment spray system effectiveness for fission product aerosol removal and pressure suppression
—blowdown tests in CSE, pressure and temperature transients during
STEEL—radiation effects on tensile properties of HSST, measurement of fast neutron (D.C.C.)

52379 (EUR–4386) PROGRESS REPORT OF THE EURATOM WORKING GROUP ON REACTOR DOSIMETRY, JULY 1964–JUNE 1968. Farinelli, U.; Coppola, M. (European Atomic Energy Community, Geel (Belgium). Central Nuclear Measurements Bureau). Feb. 5, 1969. 26p. Dep. CFSTI (U. S. Sales Only).

A review of different programs for reactor dosimetry is presented for the period July 1964 to June 1968. A bibliography of related information sources is included. (D.C.C.)

52380 (EURFNR–628) SIMULATION OF COOLANT EJECTION IN Na-2 FUEL ELEMENT. Fette, P.; Grossgarten, H. D. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Translation of report KFK–925. 16p. Dep. CFSTI.

Work Performed under United States–Euratom Fast Reactor Exchange Program.

Test apparatus and experimental procedure are described for measurements on bubble expansion in a rod cluster with original Na-2 reactor fuel element geometry. The tests show that when sodium superheating leads to in-pile perturbations due to bubble formation the bubbles will always fill the entire cross section of the fuel element. (H.D.R.)

52381 (HPR–108) OPERATIONAL EXPERIENCE WITH FAILED FUEL ASSEMBLIES AT HBWR. Ottersen, Ulf (Institutt for Atomenergi, Halden (Norway). OECD Halden Reaktor Prosjekt). Mar. 1969. 26p. (CONF-690323–1). Dep.

From Enlarged Halden Programme Group Meeting, Roeros, Norway.

Radioactivity levels released to the surroundings were measured and compared to the limitations based on international recommendations. The release of active nuclides to the moderator, their distribution, and reduction are discussed. System contamination, active handling, and personnel exposure and control are touched upon, and it is shown that the problems are more limiting from an operational point of view than releases to the surroundings. (auth)

52382 (IDO–17267) LOFT PROGRAM OFFICE. Quarterly Technical Report, October 1–December 31, 1968. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). July 1969. Contract AT(10-1)-205. 28p. Dep. CFSTI.

A coolant system fluid study and a fuel pin thermal response study were conducted to determine the response of the LOFT reactor system to a design reference accident. Depressurization of the primary coolant system to the assumed containment pressure of 40 psia was completed in 5.04 seconds. Depressurization of the secondary system occurred over a 46-second period. For the assumed design reference accident, the cladding of the hottest pin, representing 0.5 percent of the core, reached 2000°F in 64 seconds. Twenty-eight percent of the core reached 2000°F in 112 seconds, and 67 percent of the core reached 2000°F in 160 seconds. The system operational requirements of the LOFT blowdown loop have been defined and are presently being used in the design of the blowdown loop system. A study comparing the solid cruciform control rod and open-lattice control rod designs was completed for the LOFT core. The WHAM code model development effort was extended to an experimental system which simulates a pressurized-water reactor vessel. In the initial simple model, the annulus between the core support barrel and vessel wall was represented by a single pipe whose cross-sectional area is equal to the cross-sectional area of the annulus and whose length is the vessel length. The illustrative test used in this calculated-versus-experimental study simulated a single-ended break of one inlet pipe of a multi-loop PWR system. The good agreement between the calculated and experimental pressure transients tends to show that the WHAM code can predict well the pressure transients in space during subcooled blowdown. The simple model discussed is applicable to a small vessel, such as the LOFT Semiscale Blowdown vessel. (auth)

52383 (IDO–17292) FISSION PRODUCT RELEASE ANALYSIS. Baston, V. F.; Good, E. G.; Yuill, W. A. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). May 1969. Contract AT(10-1)-205. 41p. Dep. CFSTI.

Selected analytical methods for estimating fission product release from UO_2 reactor fuel under normal operation and accident conditions are reviewed. Under normal operating conditions, four empirical-based methods were considered as representative of the approaches employed for estimating fission gas release. Each of these methods is discussed and example calculations are performed for LOFT and larger reactors. The results from the calculations are tabulated and compared with one another and, where possible, with operational experimental release data. All of these methods predict results for a given case which agree to within a factor of two to three. Indications are that these release models give as realistic agreement as may be expected considering that release is a strong function of temperature and that the fuel gap conductivity as only one of many parameters is not known to better than a factor of two. As would be expected, the percentage of fission gas release, with respect to total inventory, decreases as the average linear power decreases. During core heatup under unperturbed LOCA conditions, two diffusion-based methods are considered for estimating fission product release. Each of these methods is discussed and example calculations are performed. The capability of the two methods to handle individual elements, as well as the limitations of the methods, with regard to release mechanism descriptions or to the sensitivity of parameter input data, such as heat rates, are demonstrated. The degree of refinement that will be required by both experiment and analysis in the future to describe accurately release mechanisms is indicated. (auth)

52384 (JPRS–48330, pp 369–84) TRANSIENT PROCESSES IN A GAS-COOLED REACTOR WHEN THERE IS A BREAK IN THE FIRST CIRCUIT. Poletaev, G. N. Translated from pp 395–411 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 1, Obninsk, 1967.

The basic results of a procedure for analysis of nonstationary

processes in a gas-cooled reactor when there is a break in the cooling circuit are presented. The system of equations used is described in rough approximation. Neutron dynamics and gas dynamics are considered independently of thermal dynamics. (H.D.R.)

52385 (JPRS-48330, pp 385-95) NONSTATIONARY PROCESSES IN A GAS-COOLED REACTOR WHEN THE GAS BLOWERS ARE ACCIDENTALLY CUT OFF. Poletaev, G. N. Translated from pp 412-21 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 1, Obninsk, 1967.

A method is proposed for calculating the transient processes that occur in a gas-cooled reactor when the gas blowers in the primary circuit are cut off. Expressions are formulated for the time rate of change of gas flow and for temperature variations. Relationships between transient parameters for a specific behavior of the system are examined. (H.D.R.)

52386 (JPRS-48331, pp 407-25) REDISTRIBUTION OF NUCLEAR FUEL DENSITY AND VARIATION OF REACTIVITY DURING MELTING AND RUNOFF OF CORE MATERIAL IN FAST REACTORS. Kovalevich, O. M. Translated from pp 344-64 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 2, Obninsk, 1967.

Equations are derived for determining the time distribution of the material density of a fast reactor fuel element during melting and runoff. The material distribution determines the time change of reactivity, which is necessary for evaluating the consequences of transition of the system to a prompt critical state. Numerical calculations are presented for the possible rate of reactivity buildup and the fundamental behavior of the system. (H.D.R.)

52387 (JPRS-48331, pp 658-91) SAFETY IN THE OPERATION OF FUEL RODS AND METHODS OF DETERMINING THE SAFETY FACTOR. Krett, V.; Vichek, I.; Veber, P. Translated from pp 576-605 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 2, Obninsk, 1967.

The phenomena that affect the safe operation of the fuel rods of a gas-cooled heavy-water moderated reactor are examined. General methods for determining the maximum temperature safety factors are described and compared. The effect of several factors (total safety factor) on the surface temperature of a fuel rod is analyzed and compared to the total safety factor determined by a simplified calculation using measured values of some partial safety factors. (H.D.R.)

52388 (KFK-940) SIMULATION OF COOLANT EJECTION IN SODIUM COOLED BREEDER REACTOR BY EXPERIMENTS WITH WATER. Fette, P. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Mar. 1969. 19p. (EUR-3976). Dep. CFSTI (U. S. Sales Only).

Results of experiments to simulate coolant ejection from a sodium cooled reactor core are described. The simulation was made with water rather than sodium; the apparatus and experimental setup are described. Effects of overheating, temperature profile, heat flux density and systems pressure are considered. Data are shown graphically. (M.L.S.)

52389 (ORNL-NSIC-70) INDEXED BIBLIOGRAPHY OF CURRENT NUCLEAR SAFETY LITERATURE-21. (Oak Ridge National Lab., Tenn.). Oct. 1969. Contract W-7405-eng-26. 311p. Dep. CFSTI.

A bibliography on nuclear safety is given. Material is categorized according to: General Safety Criteria; Siting of Nuclear Facilities; Transportation and Handling of Radioactive Materials; Aerospace Safety; Accident Analysis; Reactor Transients, Kinetics, and Stability; Fission Product Release, Transport, and Removal; Sources of Energy Release Under Accident Conditions; Nuclear Instrumentation, Control, and Safety Systems; Electrical Power Systems; Containment of Nuclear Facilities; Plant Safety Features; Radionuclide Release and Movement in the Environment; Environmental Surveys, Monitoring and Radiation Exposure of Man; Meteorological Considerations; Operational Safety and Experience; and Safety Analysis and Design Reports. (D.C.C.)

52390 (STI/DOC-10/88) ASEISMIC DESIGN AND TESTING OF NUCLEAR FACILITIES. Technical Reports Series No. 88. Recommendations of a Panel held in Tokyo, Japan, 12-16 June 1967. (International Atomic Energy Agency, Vienna (Austria)). 1968. 49p. IAEA $1.00. Dep.

The recommendations of a panel convened by the IAEA in Tokyo, 12-16 June 1967, are presented. Thirty-four experts from five countries and two international organizations, besides 13 observers, attended the meeting. Topics discussed are: basic philosophy of aseismic design; site selection or evaluation; aseismic design; and future action including investigations and research problems. Excerpts from the Japanese Building Code and from the US Uniform Building Code (1967) are included. (auth)

52391 UNDERSEA REACTOR SITING. Endebrock, Robert N. (Naval Nuclear Power Unit, Ft. Belvoir, Va.); D'Ardenne, Walter H.; Witzig, Warren F. Nucl. Appl. Technol., 7: 415-24(Nov. 1969).

An underwater siting guide for use in international and territorial waters must be created to evaluate the consequences of the release of fission products from a nuclear reactor sited in the ocean. Presented is an initial attempt to develop the basic equations for such a guide. A very conservative fission product release inventory to illustrate undersea application is developed consisting of 100% of the soluble and 1% of the insoluble fission products or approximately 66% of the gross fission product inventory. The ocean is divided into four distinct zones for which current velocity profiles and characteristic diffusion parameters are established. Based upon a three dimensional diffusion model incorporating shear effect and with the assumptions of no current variance, zero mean vertical current velocity, and depletion of the inventory by radiological decay only, equations are presented which describe the physical transport and dispersion of the radioisotopes. A computer program, SEADIF, is applicable to a person immersed in the water and is used to determine for both contained and uncontained systems the distance factors and the radioisotope concentrations as a function of time and position. Representative results for a 10 MW(t) system are given. 8 references. (auth)

52392 PSICO 10: A FACILITY FOR TESTING IN THE FIELD OF CONTAINMENT TECHNOLOGY FOR NUCLEAR PLANTS. Guerrini, B. (Univ. of Pisa, Italy); Lanza, S.; Mazzini, M.; Mirandola, R.; Petrangeli, G. Ing. Nucl., 10: No. 2, 10-18(Mar.-Apr. 1969).

A research program on the safety of nuclear plants containment systems is outlined. The researches will be performed using an experimental facility, whose principal component is a scale model of a pressure container, the characteristics of which are also reported. Finally the research program concerning the removal of iodine by spray systems is related. (auth)

52393 NUCLEAR SAFETY. Volume 10, Number 6. Cottrell, Wm. B.; Jordan, W. H.; Blakely, J. P.; Savolainen, A. W. (eds.). One of Four Technical Progress Reviews Published for the Division of Technical Information, USAEC. Oak Ridge, Tenn., Oak R Ridge National Lab., Nov.-Dec. 1969. 84p. GPO $0.60.

Separate abstracts were prepared for 8 of the 11 papers included. The summaries of Japan-U.S. seminar on reactor-noise analysis and general administrative activities were not abstracted for NSA. (W.H.K.)

For abstracts of individual papers see: 50545, 50546, 52102, 52301, 52302, 52394, 52395, and 52426.

52394 A MODEL FOR FISSION-PRODUCT DEPOSITION UNDER NATURAL-RESPONSE CONDITIONS IN CONTAINMENT BUILDINGS. Yuill, William A. Jr.; Baston, V. Forest (Phillips Petroleum Company, Idaho Falls, Idaho). Nucl. Safety, 10: 492-8(Nov.-Dec. 1969).

A model has been developed that describes the behavior of molecular iodine and aerosols under natural-response conditions in containment buildings. The model describes the deposition of iodine on surfaces as a diffusional process and the deposition of aerosols as being due to diffusiophoresis and thermophoresis. The effects of convectional currents were considered for each type of deposition by using standard diffusion and heat-transfer equations. 11 references. (auth)

52395 PROGRESS SUMMARY OF NUCLEAR SAFETY RESEARCH AND DEVELOPMENT PROJECTS. Savolainen, A. W.; Whetsel, H. B. Nucl. Safety, 10: 535-46(Nov.-Dec. 1969).

Summaries of nuclear safety research projects are given under the following categories: integrity of primary systems; environmental and effluent control studies; general safety studies; fast reactor safety; and gas-cooled reactor safety. 56 references. (M.L.S.)

Power Conversion Systems

Refer also to abstracts 52430 and 52433.

52396 (JPRS-48330, pp 313-24) PROSPECTS FOR USING THE STEAM GENERATOR CONCEPT OF THE FIRST CZECHO-

SLOVAK ATOMIC POWER STATION UNDER CONDITIONS OF POWER STATIONS WITH SODIUM-COOLED REACTORS. Dubsek, Frantisek. Translated from pp 335-47 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 1, Obninsk, 1967.

The four basic types of steam generators — vessel, drum, U-shaped, and modular — are evaluated from the standpoints of design, fabrication, performance, and safety for use with Na-cooled reactors. The modifications necessary for use of the modular steam generator concept of the gas-cooled A1 power reactor with Na-cooled reactors are examined, and the basic parameters of the steam generator are listed. (H.D.R.)

52397 (KFK-824) THEDYBER: A PROGRAM FOR THERMODYNAMIC CALCULATION OF THE STEAM COOLED NUCLEAR REACTOR CYCLE. Erbacher, F.; Harten, U. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorbauelemente). Aug. 1968. 211p. (In German). (EUR-4165). Dep. CFSTI (U. S. Sales Only).

The THEDYBER computer program which is used for thermodynamic calculations for the steam cooled fast breeder reactor is described and theoretical bases are given. Thermodynamic equations for the various dynamic phases of the steam and power conversion cycle are listed. The calculations for the expansion lines for the turbines are discussed. Throughput calculations are outlined. Flow diagrams show the organization of the computer program and subroutines. Input and output formats are shown. A sample problem is included. The program is written in Fortran for the IBM 360/65. (M.L.S.)

Research and Test Reactors

Refer also to abstracts 50928, 50977, 50978, 51006, 51102, 52030, 52151, 52291, 52301, 52305, 52451, 52464, and 52475.

52398 (AEEW-M-897) WINTOF: A PROGRAM TO PRODUCE NEUTRON SPECTRA FROM ZEBRA TIME-OF-FLIGHT EXPERIMENTS. Marshall, J. (Atomic Energy Establishment, Winfrith (England)). June 1969. 16p. Dep. CFSTI (U. S. Sales Only). UK 2s. 6d.

A computer program, written for the Winfrith KDF9 computer, which is used to calculate the neutron energy spectrum in the Zebra reactor from neutron time-of-flight measurements using the Zebra Linac is described. The data requirements for the program are specified and an illustration of the final spectrum is included. (auth) (UK)

52399 (BAW-3647-12) PHYSICS VERIFICATION PROGRAM. PART III. Quarterly Technical Report, January-March 1969. Pettus, W. G.; Baldwin, M. N.; Fairburn, G. T.; Stern, M. E. (Babcock and Wilcox Co., Lynchburg, Va. Critical Experiment Lab.). June 1969. Contract AT(30-1)-3647. 33p. Dep. CFSTI.

A description of the UO_2 fueled critical assembly located in Bay 2 of the Critical Experiment Laboratory is presented. Power distribution measurements for the cylindrical shaped core are listed. Design parameters for a small UO_2 and PuO_2-UO_2 water-cooled critical assembly are presented. 4 references. (D.C.C.)

52400 (BAW-3647-14) PHYSICS VERIFICATION PROGRAM. PART III. Quarterly Technical Report, April-June 1969. Pettus, W. G.; Baldwin, M. N.; Fairburn, G. T.; Stern, M. E. (Babcock and Wilcox Co., Lynchburg, Va. Critical Experiment Lab.). Sept. 1969. Contract AT(30-1)-3647. 44p. Dep. CFSTI.

Axial power distribution measurements are listed for the UO_2 fueled cylindrical critical assembly located in Bay 2 of the Critical Experiment Laboratory. Physics measurements and design parameters are presented for the UO_2 fueled Small Lattice Experiments. 3 references. (D.C.C.)

52401 (BNWL-1153) PCTR MEASUREMENT OF THE REACTIVITY EFFECTS OF 0.8 PERCENT ENRICHED URANIUM FUEL IN A GRAPHITE MODERATED LATTICE WITH VARIOUS AMOUNTS OF WATER COOLANT AND FLOODING. Vaughn, A. D.; Kilgore, M. J. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Aug. 1969. Contract AT(45-1)-1830. 55p. Dep. CFSTI.

Neutronic parameters with various water coolant and flooding conditions in a 7½ inch square pitch graphite lattice containing 0.8% enriched uranium metal fuel were measured in the Physics Constants Test Reactor. The techniques and the experimental measurements necessary to derive the infinite medium neutron multiplication factor in four cases are described; namely, two different simulated flooding conditions, normal cell conditions, and the dry cell. The neutronic parameters of an actual water flooded cell were measured and some preliminary results are derived which provide a comparison of the effects of actual water flooding with simulated flooding. All measurements were made at room temperature. (auth)

52402 (BNWL-SA-2171) AN APPLICATION PROGRAM FOR THE PROGRAMMED CONTROL AND INSTRUMENTATION SYSTEM OF A NUCLEAR REACTOR. Kosorok, J. R. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Sept. 25, 1968. Contract AT(45-1)-1830. 16p. (CONF-690812-1). Dep. CFSTI.

From Joint Automatic Control Conference, Boulder, Colo.

A digital computer has been interfaced with the High Temperature Lattice Test Reactor instrumentation and control system. The test reactor's electric heating system, rated at 384 kW, can heat it to 1000°C. Its graphite moderator is blanketed with pressurized nitrogen to inhibit oxidation. The digital computer directly controls the nitrogen and heating systems, and provides operational aids for the reactor personnel. Control techniques for four closed loops in the heating system were programmed on the computer. The basic, digital, simulation of a proportional-plus-integral controller was modified to provide several notable features: (1) aids in controller adjustment, (2) transducer signal conditioning, and (3) compensation for process nonlinearities. Other features of the control system reduce operator errors during startup and operation of the nitrogen and heat systems. A significant feature of the design of the control programs was the extensive use of hybrid simulations. (auth)

52403 (EURAEC-2097) IRRADIATIONS OF UO_2-PuO_2 CERAMIC FUELS WITH HIGH BURN-UP RATIOS. ORIENTATION EXPERIMENTS IN BOILING WATER CAPSULES. Special Report No. 11. Lhost, A.; van Oytrijve d'Ydewalle, B. (Societe Belge pour l'Industrie Nucleaire, Brussels). Feb. 1969. Contract No. 001-64-1-TRUB. 79p. (EUR-4014). Dep. CFSTI.

Work Performed under United States-Euratom Joint Research and Development Program.

The first three irradiation runs carried out in an instrumented BR-2 apparatus are described. This part of the program constitutes the orientation phase during which adjustments and improvements to the irradiation apparatus and the techniques used in the post-irradiation examinations were carried out. For this reason the average powers did not exceed 250 W/cm and the burn-up ratios 10,000 MWd/t. 17 references. (auth)

52404 (GA-9669) FAST REACTOR SPECTRUM MEASUREMENTS. Quarterly Progress Report for the Period Ending July 31, 1969. Young, J. C.; d'Oultremont, P.; Creutz, K.; Neill, J. M. (Gulf General Atomic, Inc., San Diego, Calif.). Aug. 15, 1969. Contract AT(04-3)-167. 31p. Dep. CFSTI.

EXPONENTIAL PILES — neutron spectra analysis in STSF-3 and STSF-4 (E/T)
— neutron spectra in iron reflector and reflector-core interface of STSF-2
— gamma ray pulse height spectra after intense neutron burst in STSF-2 (E)
— neutron spectra from high power target in STSF-2, foil activation measurements of
— neutron spectra in STSF-2, reentrant hole perturbation effects on
NEUTRONS, FAST — spectra in fast subcritical assemblies (E)
REACTORS, FAST — neutron spectra in, STSF measurements on
— kinetics of two-zone, two-point multigroup model for time-dependent analysis of (E/T) (H.D.R.)

52405 (GEMP-621) LOFT PROGRAM: THE EFFECT OF VARIOUS LEAKAGE RATES ON WARMUP AND COOLDOWN OF THE PRIMARY COOLANT SYSTEM. Baker, R. E. (General Electric Co., Idaho Falls, Idaho. Nuclear Systems Programs). July 2, 1968. Contract AT(40-1)-2847. 28p. (LOFT-GE-M-29). Dep. CFSTI.

The effect of various leakage rates from pump and valve seals on the warmup and cooldown of the LOFT primary coolant system and surge flow are investigated. Analytical techniques, data and assumptions necessary to the analysis are presented. Calculational details are presented and a discussion and presentation of results are given. (auth)

52406 (IDO-17302) LOFT PROGRAM OFFICE. Quarterly Technical Report, January 1-March 31, 1969. Dietz, K. A. (ed.) (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Aug. 1969. Contract AT(10-1)-205. 43p. Dep. CFSTI.

The LOFT core kinetics and heat transfer equations are presented for 50 MW power reactor conditions. The reactor control systems represented in the LOFT plant dynamic analysis are described. Accident analyses are presented for startup, rod

withdrawal at power, core inlet coolant temperature transients, and primary pump cutoff. The blowdown approximation method for analysis of noninstantaneous pipe breaks is described. 14 references. (D.C.C.)

52407 (IN-1303) CALCULATIONS OF PRESSURE-INDUCED AND THERMAL STRESSES FOR ADVANCED TEST REACTOR FUEL ELEMENTS. Moore, C. A. (Idaho Nuclear Corp., Idaho Falls). Aug. 1969. Contract AT(10-1)-1230. 48p. Dep. CFSTI.

A mathematical method was developed to determine plate deflections and stresses for the ATR fuel element geometry. Maximum stresses and deflections were calculated for interior and exterior fuel plates for extreme reactor operating conditions. The maximum fuel plate azimuthal stress was calculated to be 3217 psi for the peak power element with hot spot, hot track factors applied at beginning of core life; the yield strength of the clad material is 7400 psi at this point. Axial thermal stresses were found to be slightly above the yield strength of the clad material over small regions for the same element. Since the regions of maximum axial stress occur near the side plates and since axial thermal stress is not additive to azimuthal stress, it was concluded that minor axial yielding would not limit the fuel element performance. (auth)

52408 (IN-1308) THE MTR 25-keV NEUTRON BEAM. Howes, B. W.; Brugger, R. M.; Rogers, J. W.; Schuman, R. P.; Simpson, F. B.; Simpson, O. D. (Idaho Nuclear Corp., Idaho Falls). July 1969. Contract AT(10-1)-1230. 36p. Dep. CFSTI.

A nearly monochromatic beam of 25-keV neutrons has been obtained from the HG-5 beam facility of the Materials Testing Reactor (MTR) by using a combination of natural Fe, Al, and S filters. The actual peak energy of the beam is 24.5 ± 0.5 keV and the full-width-at-half-maximum (FWHM) is approximately 1.8 keV. This well-collimated beam has an initial diameter of 3.50 inches and a neutron flux of approximately 2×10^5 neutrons/cm^2/sec. The γ-ray field associated with the beam was found to be less than 20 mr/hr. The neutron energy spectrum of the beam has been analyzed from 1 keV to 1 MeV with a proton-recoil spectrometer. The raw proton-recoil data which were obtained with a H_2-filled detector and a multichannel pulse-height analyzer were used to "optimize" the beam, i.e., to obtain the maximum ratio between the magnitude of the 25 keV neutron peak and the general "background" level. The best "signal-to-background" ratio was obtained with 26.84 in. of Fe (99.72%), 8.22 in. of Al (99.99%), and 2.31 in. of S (99.9%). The "background" intensity has been reduced to approximately 2% of the 25 keV neutron-intensity. (auth)

52409 (INR-1058) MACROSCOPIC NEUTRON DISTRIBUTIONS IN "ANNA" REACTOR LATTICES. Adamski, L.; Jozefowicz, K.; Jozefowicz, E. T.; Elcherif, A. I. (Institute of Nuclear Research, Warsaw (Poland)). 1969. 30p. Dep. CFSTI (U. S. Sales Only).

The results of measurements of thermal neutron, epithermal neutron, and spectral parameter distributions in four regular lattices of the zero-power ANNA reactor are presented. The distributions were measured along the vertical experimental channels, along two perpendicular horizontal axes and in the horizontal plane of symmetry of the core. The axial buckling values were determined. (auth)

52410 (JPRS-48330, pp 553-90) MONITORING HERMETICITY OF HEAT GENERATING ELEMENTS OF BR-5 REACTOR, REMOVING RADIOACTIVE FISSION PRODUCTS FROM SODIUM AND INERT GAS. Aristarkhov, N. N.; Efimov, I. A.; Krasnoyarov, N. V.; Mamaev, L. I.; Filonov, V. S.; Shereshkov, V. S.; Kulikov, Yu. K.; Kravchenko, V. P.; Pankov, A. M. Translated from pp 561-93 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 1, Obninsk, 1967.

When fuel elements of the BR-5 were operated to high burnups, some of the jackets lost their leak tightness. This resulted in fission product contamination of the Na coolant in the primary circuit. The system used to monitor radioactivity levels in the Na and in the cover gas is described and some results of measurements are presented. The system for monitoring the leak tightness of the fuel element jackets is also described. (H.D.R.)

52411 (JPRS-48331, pp 199-257) SURVEY OF FAST-REACTOR PHYSICS WORK PERFORMED ON THE BR-1, IBR, AND BFS REACTORS. Leipunskii, A. I.; Orlov, V. V.; Nikolaev, M. N.; (and others). Translated from pp 177-224 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 2, Obninsk, 1967.

The BR-1 reactor and some of its features for experimental reactor physics studies are described. A series of exponential measurements on the propagation of neutrons in various media and on the characteristics of weak breeder materials for use in blanket regions are summarized. The IBR reactor was used for time-of-flight measurements on the neutron spectra emerging from samples of the materials studied in the BR-1 measurements. The BFS fast critical facility is described, and some of the characteristics of the various assemblies studied during 6 years of operation are presented. A detailed account is given of the use of the BFS for studies of critical mass, fission and capture processes, breeding ratio, reactivity worths, and neutron spectra and lifetime. 38 references. (H.D.R.)

52412 (LA-4208) REEVALUATED CRITICAL SPECIFICATIONS OF SOME LOS ALAMOS FAST-NEUTRON SYSTEMS. Hansen, G. E.; Paxton, H. C. (Los Alamos Scientific Lab., N. Mex.). June 1969. Contract W-7405-eng-36. 13p. Dep. CFSTI.

Reevaluation of a number of published critical masses of Los Alamos fast neutron critical assemblies is presented. In each case, there is idealization to the appropriate one-dimensional or two-dimensional representation. Minor changes of some published critical specifications result either from improvement of data upon which corrections are based or from more detailed accounting of component dimensions than was originally believed to be justified. 11 references. (auth)

52413 (NYO-1859-4) NUCLEAR REACTOR FACILITY. Fourteenth Annual Progress Report, July 1, 1968-June 30, 1969. (Pennsylvania State Univ., University Park. Dept. of Nuclear Engineering). Contract AT(30-1)-1859. 74p. Dep. CFSTI.

Operations and research programs performed in the Penn State TRIGA Reactor during July 1968 to June 1969 are described. Training programs are also described. (D.C.C.)

52414 (ORNL-TM-2676) OPERATING MANUAL FOR THE 2 MW BULK SHIELDING REACTOR. Costner, R. A. Jr.; Culbert, W. H.; Hurt III, S. S.; Tabor, W. H. (Oak Ridge National Lab., Tenn.). Aug. 5, 1969. 559p. Dep. CFSTI.

The BSR is a swimming-pool-type reactor. It has the capabilities of continuous operation at a power level of 2 MW or at any desired lower power level. Descriptive and operational information is presented. The reactor and its ancillary facilities are described from a physical and operational viewpoint. Detailed operating procedures are included which are applicable from source-level startup to full-power operation. Also included are procedures relative to the safety of personnel and equipment in the areas of experiments, radiation and contamination control, emergency actions, and general safety. (auth)

52415 (UCRL-71736) MULTIPLE FAILURES OF MTR-TYPE FUEL ELEMENTS AT THE LPTR. Eagan, James L. (California Univ., Livermore. Lawrence Radiation Lab.). Sept. 10, 1969. 21p. (CONF-691009-4). Dep. CFSTI.

From Conference on Reactor Operating Experience, San Juan, Puerto Rico.

Fuel element failures in the Livermore Pool-Type Reactor during 1968 and 1969 are analyzed. Photographs of the failed and damaged fuel elements are included. 2 references. (D.C.C.)

52416 DOSIMETRIC INTERCOMPARISON MEASUREMENTS IN THE CORE OF REACTOR ISIS AT SACLAY. Radak, B. (Boris Kidric Inst. of Nuclear Sciences, Vinca, Yugoslavia); Gal, O.; Markovic, V.; Petkovic, Lj.; Labrousse, M.; Libmann, J.; Roger, J. Nucl. Appl. Technol., 7: 409-14(Nov. 1969).

Dosimetric intercomparison in the core of ISIS reactor was performed using two different types of calorimeters: a pedestal differential device and a heat-flow calorimeter. The results obtained in graphite and polyethylene as reference materials were intercompared for both types of calorimeters and an agreement within a few per cent was obtained. From the neutron measurements, the neutron dose rates were calculated and compared to the values derived from calorimetry; agreement within 15% was obtained. Several chemical dosimetric systems (i.e., oxalic acid dissolved in light and heavy water, solid oxalic-, malonic-, and succinic acid) were irradiated and the curves of dose-effect obtained. (auth)

52417 RESULTS OF EIGHT YEARS OPERATION OF THE BR-5 REACTOR. Leipunskii, A. I.; Kazachkovskii, O. D.; Ovechkin, D. M.; (and others) (Physical-Energetics Inst., Obninsk, USSR). Kernenergie, 12: 264-71(Aug. 1969). (In Russian).

Operation experiences for the BR-5 (U.S.S.R.) reactor are presented for 1959 to 1967. (auth)

52418 ON-OFF CONTROL SYSTEM FOR THE REGULATION OF NEUTRON FLUX IN THE PEC REACTOR. Cimorelli, L.; Cosimo, E. (CNEN, Casaccia, Italy). Ing. Nucl., 10: 7-19(Jan.-Feb. 1969). (In Italian).

The parametric studies of control systems for the PEC Fast Test Reactor are described. Transfer functions for the reactor are given; the Fourier analyses of the system are described briefly. Results of the analytical methods are summarized. Results of neutron flux measurements are shown; analytical and analog data are compared. (M.L.S.)

52419 DETERMINATION OF THE REACTIVITY VALUES OF STRONG NEUTRON ABSORBERS IN THE IRRADIATION POSITIONS OF A REACTOR. Menke, H. (Univ., Mainz). Kerntechnik, 11: 441-3(Aug. 1969). (In German and English).

The reactivity worth of neutron absorbers of various strengths were measured in the most important irradiation facilities of the reactor TRIGA Mainz. The experiments show that it is possible to assess in advance the reactivity values of chemical irradiation samples. Also investigated was the maximum positive reactivity variation due to the rapid withdrawal of such samples which can be compensated by the automatic control system of the reactor without producing a scram. 4 references. (auth)

52420 SAMPLE IRRADIATION FACILITY IN A BEAM TUBE AT THE REACTOR FRG-1. Kolb, M.; Krull, W. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt mbH, Geesthacht, Ger.). Kerntechnik, 11: 444-7(Aug. 1969). (In German and English).

A sample irradiation facility at the Geesthacht research reactor FRG-1 is described which makes it possible to irradiate large dry samples (9 cm diameter × 30 cm long) at a thermal neutron flux density ranging from about 10^{13} down to about 10^{9} cm^{-2} s^{-1}. A manipulation cell makes it possible to handle samples with activities of up to 15 Ci ^{60}Co-equivalent. When the FRG-1 is shut down it is possible to use the sample irradiation facility for γ irradiations at exposures from 10^{8} down to 10^{2} R. 9 references. (auth)

52421 IRRADIATION RIG FOR IRRADIATING SOLID SPECIMENS UP TO 1000°C. Ahlf, J.; Anders, D.; Hilgendorff, W. (Institut fuer Reaktorphysik, Geesthacht, Ger.). Kerntechnik, 11: 448-52(Aug. 1969). (In German and English).

A rig for the in-pile irradiation of solid specimens in the temperature range from 200 to 1000°C is described together with its auxiliary equipment. The operation of the rig is briefly discussed. 3 references. (auth)

52422 NEW PERSONNEL LOCK AT THE GEESTHACHT RESEARCH REACTOR. Petersen, G. (Institut fuer Reaktorphysik, Geesthacht, Ger.). Kerntechnik, 11: 453-6(Aug. 1969). (In German and English).

In connection with the increase of the power output of the reactor FRG-2 a new personnel lock had to be built. The lock doors designed by the technical office of the Reactor Station are described. (auth)

52423 FACILITY FOR SEED IRRADIATIONS WITH FAST NEUTRONS IN SWIMMING-POOL REACTORS. A Design Study. Burtscher, A.; Casta, J. pp 41-61 of Neutron Irradiation of Seeds. Vienna, International Atomic Energy Agency, 1967.

From Panel Meeting on the Use of Neutrons in Seed Irradiation, Vienna, Austria.

From Meeting on Recommendations for a Neutron Seed Irradiation Programme, Vienna, Austria. See STI/DOC-10/76; CONF-660703; CONF-661218.

Design parameters of an irradiation facility for the ASTRA Reactor are presented. The facility consists of a cylindrical lead shield and a neutron filter to reduce the γ dose and the thermal neutron flux. Physics calculations for optimum parameters are included. 5 references. (D.C.C.)

52424 NEUTRON-IRRADIATION EXPERIMENTS WITH BARLEY SEEDS IN THE ASTRA REACTOR (AUSTRIA). Mikaelsen, K.; Casta, J. pp 63-7 of Neutron Irradiation of Seeds. Vienna, International Atomic Energy Agency, 1967.

From Panel Meeting on the Use of Neutrons in Seed Irradiation, Vienna, Austria.

From Meeting on Recommendations for a Neutron Seed Irradiation Programme, Vienna, Austria. See STI/DOC-10/76; CONF-660703; CONF-661218.

Physics measurements for a fast neutron irradiation facility of the ASTRA Reactor are presented. The facility consists of a cylindrical lead shield and a neutron filter to reduce the γ dose and thermal neutron flux. (D.C.C.)

52425 FAST-NEUTRON DOSIMETRY IN THE SEED-IRRADIATION FACILITY, ASTRA REACTOR, SEIBERSDORF. Ahnstroem, G.; Burtscher, A.; Casta, J. pp 87-102 of Neutron Irradiation of Seeds. Vienna, International Atomic Energy Agency, 1967.

From Panel Meeting on the Use of Neutrons in Seed Irradiation, Vienna, Austria.

From Meeting on Recommendations for a Neutron Seed Irradiation Programme, Vienna, Austria. See STI/DOC-10/76; CONF-660703; CONF-661218.

A pair of constant potential ionization chambers have been constructed at the Institute of Biochemistry, Stockholm University. These chambers are the same size as the seed-irradiation vials to be used in the seed-irradiation container (dia = 15 mm, length = 60 mm). Some preliminary dosimetry experiments were undertaken to test the irradiation facility and the ionization chambers, and to investigate the usefulness of the dosimetry instructions. 3 references. (auth)

52426 POWER-UPRATING EXPERIENCE FOLLOWING CONVERSION OF A POOL REACTOR FROM PLATE-TYPE TO TRIGA FUEL ELEMENTS. Randall, John D. (Texas A and M Univ., College Station). Nucl. Safety, 10: 522-30(Nov.-Dec. 1969).

Typical modifications required to convert a pool reactor to the use of TRIGA fuel are relatively minor. They include new control-system interlocks and fuel-element thermocouples, and, if pulsing capability is included, a pneumatic control-rod drive and pulse instrumentation are required. Following conversion, which is an ideal time to make other improvements, most problems occur from power uprating, including maintaining adequate excess reactivity for xenon override, power and control-rod calibration, instrumentation linearity, and increased radioactivity-level effects on maintenance, irradiated-sample handling, and radiation monitoring. With a little foresight and preparation, many potential problems can be avoided. 23 references. (auth)

Rocket and Space Reactors

Refer also to abstracts 50054 and 51081.

52427 (N-69-31870) NERVA CONTROL DRUM ACTUATOR IRRADIATION TEST PROGRAM. Robinson, David J.; Mayer, John T.; Wyer, Richard R. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). July 1969. 46p. (NASA-TN-D-5347). CFSTI.

A test program was conducted to evaluate the NERVA control drum actuator in the environments of cryogenic temperature, nuclear radiation, and vacuum. The actuator was irradiated for 21.8 hours with a total gamma dose of 1.3×10^{11} ergs per gram (1.3×10^{9} Rads) and a neutron fluence of 2×10^{16} neutrons per square centimeter without any degradation in performance. Further irradiation testing was attempted but the actuator malfunctioned. A postirradiation examination revealed extensive radiation damage to the feedback potentiometer. Other actuator components showed no significant radiation damage that would produce detectable changes in actuator performance. (auth) (STAR)

52428 PROPULSION SYSTEMS FOR MANNED EXPLORATION OF THE SOLAR SYSTEM. Moeckel, Wolfgang E. (Lewis Research Center, Cleveland). Astronaut. Aeronaut., 7: 66-77(Aug. 1969).

Gaseous nuclear fission and thermonuclear fusion rockets as propulsion systems for fast interplanetary travel are reviewed. The relation between propulsion-system performance and planetary-mission capability is reviewed. The anticipated performance is analyzed for the chief advanced-propulsion concepts, ranging from fairly well-defined systems, such as solid-core, nuclear-fission rockets, to quite speculative systems, such as the thermonuclear-fusion rockets. Missions and systems are matched to indicate how far and how fast man may go in the foreseeable future. Two types of propulsion systems (called specific-impulse-limited, or high-thrust systems, and specific mass-limited systems) are defined. A comparison is made of the requirements for the 2 types of propulsion systems for Jupiter and Neptune trips. Graphs are cited to give an idea of the relation between propulsion-system capability and mission difficulty. The propulsion concepts that look promising, the performance parameters that seem achievable, and the nature of the limitations on these parameters are discussed. Liquid-core and gaseous-core nuclear-fission rockets have been studied analytically, with some experimental evaluation of critical processes. For liquid-core rockets, specific-impulse limits of 1300 to 1500 sec are calculated with thrust-to-weight ratios of 2 to 10. For gaseous-core nuclear fission rockets, specific impulses in the range of 1500 to 2500 sec seem theoretically feasible, with engine thrust-to-weight ratios of 1 or more. Some projected performance figures for these nuclear-fission types are given. 44 references. (BBB)

Process Heat and Desalination Reactors

Refer also to abstract 52305.

52429 (JPRS-48330, pp 123-50) THE BN-350 ATOMIC ELECTRIC POWER PLANT. Leipunskii, A. I.; Afrikantov, I. I.; Orlov, V. V.; (and others). Translated from pp 123-50 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 1, Obninsk, 1967.

The BN-350 nuclear power station consists of a sodium-cooled fast reactor for the production of 150 MW(e) and the desalination of 120,000 cubic meters of water per day. The basic characteristics of the installation as a whole, descriptions of individual units and reactor components, and some design test results are presented. (H.D.R.)

52430 (JPRS-48330, pp 252-68) HEAT EXCHANGE EQUIPMENT OF THE BN-350 REACTOR. Leipunskii, A. I.; Stekol'nikov, V. V.; Pinkhasik, M. S.; (and others). Translated from pp 269-86 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 1, Obninsk, 1967.

Heat-transfer from the BN-350 reactor is by two sodium circuits and a water–steam circuit. The designs selected for the intermediate sodium–sodium heat exchanger and the sodium–water steam generator are described. The stand used for testing the thermohydrodynamic characteristics of the heat transfer equipment is described. (H.D.R.)

52431 (JPRS-48330, pp 269-92) SODIUM CIRCULATING PUMPS OF THE BN-350 ATOMIC ELECTRIC POWER STATIONS. Afrikantov, I. I.; Sharonov, V. I.; Kostin, V. I.; Klyukov, B. P.; Pinkhasik, M. S.; Budov, V. M.; Rineiskii, A. A. Translated from pp 287-311 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 1, Obninsk, 1967.

The BN-350 sodium pumps are sealed single-stage centrifugal units. The electric motors are two-speed squirrel-cage models. Technical characteristics of the pumps are presented. Model pumps were tested for operating characteristics. Results of tests are described for bearings, shaft end seals, magnitudes of axial hydraulic forces in the pumps, gas capture and transfer to the coolant, and starting and transient operating conditions. (H.D.R.)

52432 FRANCE'S PROGRAM ON NUCLEAR DESALINATION. Balligand, P. (CEN, Grenoble, France). Desalination, 6: 287-91(Aug. 1969). (In French).

Research and development activities in France on nuclear desalination are reviewed. Methods and materials studies being conducted are examined, and various government and industry organizations active in desalination studies are listed. (H.D.R.)

52433 NUCLEAR INDUSTRIAL DESALINATION PLANT WITH FAST NEUTRON REACTOR AT SHEVCHENKO. Novikov, E. P.; Chernozubov, V. B.; Golub, S. I.; (and others) (Sverdlovsk Chemical Engineering Science Research Inst., USSR). Desalination, 6: 349-67(Aug. 1969).

Two sea water distillation plants heated by steam from thermoelectric plants are operating at the town of Shevchenko in the U.S.S.R. Both plants are multiple effect once-through evaporation installations with crystal seeding for the prevention of scale formation. The performance and operating experience of these plants are reviewed. Studies on the corrosion resistance of various construction materials and on methods for heat transfer improvement are described. Flow sheets and design parameters of two plant concepts for use with the BN-350 fast reactor are presented. (H.D.R.)

Marine and Portable Power Reactors

Refer also to abstracts 50977 and 52319.

52434 NUCLEAR POWER OPERATIONS, DEEP FREEZE 68-69. Groover, Edwin D. (Naval Nuclear Power Unit, Fort Belvoir, Va.). Antarctic J. U. S., 4: 151-3(July-Aug. 1969).

Successful operation of the PM-3A nuclear power plant during Crew VII's Deep Freeze 68 tenure is described. Major projects accomplished during the Deep Freeze 69 summer included the installation of a resistor in the neutral bus of the PM-3A main generator, relocation of the high-pressure demineralizer to a position outside the containment system, and replacement of the pressurizer relief valves. The nuclear power plant's availability to meet McMurdo Station's electrical power requirements for calendar year 1968 was 85.05%, down 1.19% from the previous year. However, both total electrical production and amount of exported electrical energy increased to 10^7 KWh and 7.86×10^6 KWh respectively. The plant's availability and electrical energy production are summarized for the years 1962 to 1968. (BBB)

52435 ARE NUCLEAR SHIPS THE ANSWER. Will, John M. (American Export Isbrandtsen Lines Inc., New York). Oceanol. Int., 4: 33-5(July-Aug. 1969).

Second-generation nuclear ships appear to be borderline competitively. The 1968 study of the General Dynamics Corporation concluded that the total capital cost to the shipowner for 3 ships on Trade Route 12 without subsidy would be $61.9 million, compared to $43 million for 3 conventionally powered ships. With maximum government subsidy, the cost would be $25.2 million for the nuclear and $25.4 million for the conventional ships. Annual operating costs were estimated at $14.3 million for the 3 nuclear ships and $13 million for the conventional without subsidy, and $11.2 million and $11.5 million, respectively, with maximum government subsidy. Fuel costs will be 2.2 mill/shaft horsepower hr for the first nuclear core. In a 7-yr period, these costs will drop to 1.7 mill/SHPH, less than half that of a fossil-fuel ship. (BBB)

Production Reactors

52436 (DUN-SA-112) REACTOR FUEL REMOVAL FOLLOWING A COOLANT FLOW STOPPAGE. Heacock, H. W.; Ambrose, T. W. (Douglas United Nuclear, Inc., Richland, Wash.). Aug. 20, 1969. Contract AT(45-1)-1857. 28p. (CONF-691009-1). Dep. CFSTI.

From Conference on Reactor Operating Experience, San Juan, Puerto Rico.

Details of a coolant flow stoppage incident are presented. The recovery activities are described. Only a minimal amount of reactor outage time was caused by the incident and there were no serious radiation exposures to the personnel involved nor were there significant radiation exposures to the environs. (auth)

52437 (DUN-SA-114) DEACTIVATION OF HANFORD REACTOR FACILITIES. Schroeder, O. C. (Douglas United Nuclear, Inc., Richland, Wash.). Aug. 25, 1969. 47p. (CONF-691009-3). Dep. CFSTI.

From Conference on Reactor Operating Experience, San Juan, Puerto Rico.

Procedures for the deactivation and disassembly of the Hanford Production Reactors and related buildings and facilities are described. (D.C.C.)

52438 (DUN-SA-120) OPERATING PHYSICS EXPERIENCE AT HANFORD. Hamric, J. P. (Douglas United Nuclear, Inc., Richland, Wash.). [nd]. Contract AT(45-1)-1857. 25p. (CONF-691009-2). Dep. CFSTI.

From Conference on Reactor Operating Experience, San Juan, Puerto Rico.

The three reactor physics concepts and techniques discussed are applicable in principle to any neutronically large reactor system. Kinetics relationships developed for the specific hardware systems illustrate the technical bases applicable in the nuclear safety analyses of any reactor system. The theoretical model for Xe cycling may be related to a soundly based empirical method to ensure its control. Finally, the common relationship between inverse count rate and degree of subcriticality provides a useful tool for detection and assessment of unexpected reactivity conditions in shutdown reactors. 4 references. (auth)

52439 (DUN-SA-126) HANFORD REACTOR OPERATING PERSONNEL RETRAINING AND TESTING. Bursey, R. J.; Edwards, T. E. (Douglas United Nuclear, Inc., Richland, Wash.). Sept. 19, 1969. Contract AT(45-1)-1857. 11p. Dep. CFSTI.

Reactor Theory

Refer also to abstracts 51857, 52354, and 52438.

52440 (AEEW-M-889) COARSE MESH CORRECTION FOR COLLISION PROBABILITIES. Askew, J. R. (Atomic Energy Establishment, Winfrith (England)). June 1969. 10p. Dep. CFSTI (U. S. Sales Only). UK 2s. 6d.

A simple method, based upon diffusion theory, is shown to provide a useful correction to collision probabilities in circumstances where the flat emission density assumption made in their calculation has broken down. It is expected that the correction will be of use in design calculations, and especially to multi-cell (or synthetic) models of complicated reactor geometries where more refined models are not available. (auth) (UK)

52441 (AEEW-M-903) TOFFEE: A FORTRAN PROGRAMME FOR CALCULATING DIRECTED FLUX SPECTRA. Macdougall, J. D. (Atomic Energy Establishment, Winfrith (England)). Aug. 1969. 7p. Dep. CFSTI (U. S. Sales Only). UK 2s.

TOFFEE is a KDF9 program to edit the fine group ($1/128$ lethargy) cell fluxes obtained from a MURAL calculation into a suitable form for interpretation of experimental neutron spectrum measurements. The program may compute the flux spectrum arriving at the detector in a time-of-flight experiment for perpendicular or parallel plate orientation at the source plane in the reactor, or alternatively may compute the cell averaged spectrum which is the spectrum generally observed by within reactor spectrometers. In addition it is possible to calculate the effect on the spectrum of observing it with a Gaussian resolution function with a constant lethargy width. (auth) (UK)

52442 (AEEW-R-631) METHUSELAH III: A FORTRAN PROGRAM AND NUCLEAR DATA LIBRARY FOR THE PHYSICS ASSESSMENT OF LIQUID-MODERATED REACTORS. Brinkworth, M. J. (Atomic Energy Establishment, Winfrith (England)). Jan. 1969. 26p. Dep. CFSTI (U. S. Sales Only). UK 4s.

METHUSELAH III has been developed from METHUSELAH II by introducing improvements and additional facilities into the program and by revising the nuclear data library. These developments are described, and information is given on the coding and usage of METHUSELAH III on the IBM 7030 (STRETCH) computer and of an improved version of METHUSELAH II on the KDF9 computer. (auth) (UK)

52443 (AI-AEC-12820) SPECTRUM SYNTHESIS IN FAST REACTOR ANALYSIS. Vaughan, E. U.; Rose, P. F.; Hausknecht, D. F. (Atomics International, Canoga Park, Calif.). June 30, 1969. Contract AT(04-3)-701. 106p. Dep. CFSTI.

The synthesis method has been applied to fast reactor calculations in the form of spectrum synthesis, in which the neutron distribution in a region is represented approximately as a linear combination of a few predetermined energy spectra (the basis spectra), the coefficients being space-dependent functions the (mixing functions). Equations to determine the mixing functions are obtained in several ways which include the standard variational and Galerkin methods, and the group balance method in which the original multigroup equations are replaced by conditions of neutron balance in a number of coarse groups equal to the number of basis spectra. The equations have been cast into a form suitable for solution by the one-dimensional, few-group, diffusion-theory code RAUM, which has been generalized by relaxing the restrictions that the matrix of diffusion coefficients be diagonal and the scattering transfer matrix be triangular. Codes have been written to translate multigroup cross-section libraries into the matrices required by RAUM, and also to construct synthesized spectra from the RAUM output. This can be done even when different regions use different basis spectra, provided the group balance method is used, with the same coarse groups in all regions. A number of calculations using this synthesis scheme are reported, mostly on the critical assembly ZPR-3-48, with or without partial voiding of sodium, using a two-fold or three-fold spectral basis consisting of typical spectra, found in a calculation with the one-dimensional multigroup diffusion-theory code CAESAR. Comparison of the RAUM and CAESAR calculations indicates that the multiplication factors generally agree to a few tenths of a percent, and that power distributions, and spectra at individual points (especially in the core), usually agree well also. But these favorable indications are qualified by occasional failures, in which RAUM gives very unphysical results. Such failures can be avoided by proper choice of the coarse groups for the group balance method, and evidence is presented that bad choices can be recognized by studying the RAUM input matrices they yield, without the need for a complete RAUM calculation. (auth)

52444 (BNWL-831(Rev.1)) 2DB USER'S MANUAL, Revision 1. Little, W. W. Jr.; Hardie, R. W. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Aug. 1969. Contract AT(45-1)-1830. 142p. Dep. CFSTI.

2DB is a two-dimensional (X-Y, R-Z, R-θ, triangular), multigroup diffusion code for use in fast reactor criticality and burnup analysis. All programming is in FORTRAN-IV. Since variable dimensioning is employed, no simple restrictions on problem complexity can be stated. However, in a 65K memory, the current version is nominally restricted to 50 energy groups. Running time (for a k_{eff} calculation) on a UNIVAC 1108 is about 1 minute for a 30×30 mesh problem using 4 energy groups. 6 references. (auth)

52445 (BNWL-1162) PERT-V: A TWO-DIMENSIONAL PERTURBATION CODE FOR FAST REACTOR ANALYSIS. Hardie, R. W.; Little, W. W. Jr. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Sept. 1969. Contract AT(45-1)-1830. 97p. Dep. CFSTI.

PERT-V is a two-dimensional perturbation theory code for use in fast reactor analysis. The code will: compute reactivity coefficient traverses using first order perturbation theory; compute the effective delayed neutron fraction, the neutron generation time, and the inhour/δk conversion factor; and compute activity traverses. The code was written to be compatible with the BNW one- and two-dimensional diffusion theory codes 1DX and 2DB, and the Los Alamos one- and two-dimensional transport theory codes DTF-IV and 2DF. All five codes use the same input module. PERT-V is written entirely in FORTRAN-IV. Variable dimensioning is utilized to make maximum use of available core storage. Running time for a 13 group 30×30 mesh problem on a UNIVAC 1108 is about 1 minute. 4 references. (auth)

52446 (EUR-4285) CRITICALITY PROBLEMS IN THE ESSOR PLANT. Ragusa, S.; Ricchena, R. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). 1969. 46p. (In Italian). Dep. CFSTI (U. S. Sales Only).

Some installations annexed to the ESSOR reactor, which are part of the Essor Plant, are designed to receive fuel elements: an inspection and, eventually, disassembling laboratory, new elements storage room, and a decay pool for irradiated fuel elements. The three different fuel elements used in the reactor are described (sintered uranium and aluminum enriched at 5%, UO_2 enriched at 1.8% and UC enriched at 1.8%); for each element, criticality calculations have been performed for two different lattices, and for foreseeable operating and accident conditions (storage, loading and unloading, disassembling, flooding, melting). The verification has been made by comparison with standard critical configurations literature or by calculations of the multiplication constant, with the aid of the DTF_4 code by means of the Hansen and Roach cross sections library modified in order to take into account the resonance absorption of ^{238}U. As far as possible, a configuration has been verified with both procedures. Finally, the safety operating rules resulting from these calculations have been established. (auth)

52447 (EURFNR-613) CALCULATION OF HETEROGENEITY EFFECTS IN PERIODIC CELL STRUCTURES OF THERMAL AND FAST NUCLEAR REACTORS. Wintzer, D. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Kernphysik). Translation of report KFK-743. 48p. Dep. CFSTI.

Work Performed under United States-Euratom Fast Reactor Exchange Program.

A method is described to calculate heterogeneity effects with an acceptable calculation time, a uniform method, and few limiting assumptions as to the lattice cell geometry. The space and energy transport models in which the method was worked out are presented. The mathematical treatment yields a linear equation system for the emission density, for whose coefficients a uniform computer instruction is given. The physical significance of these coefficients ("reaction coefficients") is discussed; the resonance problems boil down to its calculation. The use of self-shielding factors or group resonance integrals in calculating the reaction coefficients is described. Equivalence theorems of the Bell approximation type occur as special cases. Simple diffusion corrections, which are of importance for calculation of the space distribution of reaction ratios inside a lattice cell and lead to heterogeneity corrections of the neutron outward flux and thus of reactivity, are described. The calculation of "heterogeneity-corrected" group cross-sections for multigroup diffusion codes applicable to homogenized reactor zones is described. The aim is to calculate the influence of the heterogeneous cell structure on the spectrum (averaged across the lattice cell), mean neutron lifetime, Doppler coefficients, void coefficients and reactivity of multizone reactors. Some application examples for fast and thermal reactors are included. (auth)

52448 (EURFNR-681) METHOD TO CALCULATE REACTIVITY WORTH BY INTEGRAL TRANSPORT THEORY. Fischer, E. A. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). June 1969. 17p. (KFK-995; EUR-4301). Dep. CFSTI (U. S. Sales Only).

Work performed under United States-Euratom Fast Reactor Exchange Program.

An integral transportation perturbation method is described for analyzing the reactivity worth of 2 zone assemblies. The assembly zones consist of the sample and the surrounding core. Comparisons with the first order perturbation method and experimental values are included. 8 references. (D.C.C.)

52449 (INR-1062) MIXER CODE. Kulikowska, T. (Institute of Nuclear Research, Warsaw (Poland)). 1969. 51p. Dep. CFSTI (U. S. Sales Only).

The MIXER code prepares the 26-group macroscopic constants in a form suitable for direct use in the one-dimensional criticality code EWA-TAPE. The programme library is based on the 26-group Russian constants elaborated by L. Abagian et al. The MIXER library is stored on a magnetic tape. The code calculates a self-shielding correction making use of the self-shielding factors given in the Abagian's library for 300°K, i.e., the code in its present version is destined for calculations of cold systems only. The programme is written in GIER-Algol 3 for the GIER computer with one magnetic drum and one unit of buffer memory /4K/. One magnetic tape station is needed during programme operation. (auth)

52450 (JPRS-48330, pp 355-68) KINETICS OF A GAS-COOLED FAST REACTOR IN THE REGION OF SMALL PERTURBATIONS. Poletaev, G. N. Translated from pp 381-94 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 1, Obninsk, 1967.

A system of equations for the approximation of nonstationary processes in a three component (fuel–cladding–coolant) reactor is described. Expressions are formulated for conditions necessary for reactor stability, the effect of perturbations with respect to the rate of coolant flow and temperature at input to the reactor, nonstationary processes in reactivity perturbations, and the effect of neutron regulation on nonstationary processes. (H.D.R.)

52451 (JPRS-48331) CEMA SYMPOSIUM ON ATOMIC POWER STATIONS WITH FAST REACTORS. VOLUME II. Translation of Simpozium SEV: Sostoyanie i Perspektivy Robot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Obninsk, 1967. 691p. (CONF-671220-(Vol.2)). CFSTI.

Thirty papers are included in Volume II. A separate abstract was prepared for each paper. (J.R.D.)

For abstracts of individual papers see: 50986, 51077, 51078, 52171, 52311, 52312, 52323–52326, 52330, 52333, 52339, 52350–52352, 52371, 52386, 52387, 52411, 52452–52460, and 52487.

52452 (JPRS-48331, pp 2-50) SUPPLYING FAST REACTOR NEUTRON CALCULATIONS WITH GROUP CONSTANTS AND THE REQUIREMENTS FOR NUCLEAR DATA. Nikolaev, M. N. Translated from pp 5-49 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 2, Obninsk, 1967.

The Physics and Power Engineering Institute projects in the compilation of constants for fast reactor physics calculations are reviewed. Activities with respect to analysis of experimental data, selection of recommended cross sections, compilation of group constants, and experimental verification of constants are described. Methods for calculations on neutron propagation in various media are discussed. The accuracy of existing nuclear data is estimated and the effect of errors in group constants on the accuracy of calculations of physics characteristics of fast reactors is examined. Nuclear data accuracy requirements and the state-of-the-art with respect to the improvement of group constants are discussed. The role of critical and exponential experiments in improving the accuracy of fast reactor calculations is examined. 51 references. (H.D.R.)

52453 (JPRS-48331, pp 51-73) EXPERIMENTAL STUDIES OF NUCLEAR CONSTANTS FOR FAST REACTORS. Stavisskii, Yu. Ya.; Kuznetsov, V. F.; Abramov, A. I.; Van'kov, A. A.; Kononov, V. N.; Tolstikov, V. A.; Shapar, A. V.; Popov, V. I. Translated from pp 50-68 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 2, Obninsk, 1967.

The accuracy of experimental nuclear constants that are used in calculations of fast reactor characteristics is examined. Experimental methods used and nuclear data obtained by various nuclear laboratories are reviewed. The accuracy attained by the spread of results cited in separate papers is discussed. Data are compared and evaluated for the fission of nuclei, the radiative capture of neutrons, and the scattering of neutrons. 78 references. (H.D.R.)

52454 (JPRS-48331, pp 82-105) METHODS OF CALCULATING FAST REACTORS. Nikolayshvili, Sh. S.; Lyashenko, E. I.; Markelov, I. P.; Mironovich, Yu. N.; Nevinitsa, A. I.; Polivanskii, V. P. Translated from pp 75-96 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 2, Obninsk, 1967.

A brief review of the numerical algorithms and programs for fast reactor calculations on the M-20 computer developed at the Physics and Power Engineering Institute is presented. Included are: a general statement of the problem of multigroup calculation of the spatial-energy distribution of the neutrons in nuclear reactors; numerical methods of calculating one-dimensional and two-dimensional reactors in the P_1 and P_2 approximations of the method of spherical harmonics; a numerical scheme for multigroup calculation of one-dimensional reactors in the P_n-approximation with application of matrix factorization; the finite-difference Carlson method with acceleration of convergence of successive approximations using the approximation of the Ivon-Martens type; a numerical algorithm for solving the partial problem of eigenvalues; and a review of the most important programs of the Physics and Power Engineering Institute for the M-20 computers based on the above-mentioned methods. 15 references. (auth)

52455 (JPRS-48331, pp 106-22) EFFECTIVE METHODS OF CALCULATING THE NEUTRON FIELD IN A NUCLEAR REACTOR. Khromov, V. V.; Slesarev, I. S.; Kuz'min, A. M. Translated from pp 97-114 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 2, Obninsk, 1967.

The development of effective algorithms for the calculation of the space-energy and angular distribution of neutrons in a reactor is examined. The algorithms presented are constructed under the assumption that the neutron flux as a function of two or more variables can be represented in different form in different regions of variation. (H.D.R.)

52456 (JPRS-48331, pp 125-38) PROGRAMS FOR CALCULATING FAST CRITICAL SYSTEMS. Arkuszewski, Ja.; Borysiewicz, M.; Woznicki, E.; Guzinski, W. Translated from pp 115-25 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 2, Obninsk, 1967.

General information about two computer programs developed at the Institute of Nuclear Research in Swierk is presented. The first (EWA-TAPE) is a one-dimensional diffusion multigroup code which can solve critical problems in plane, cylindrical and spherical geometry. The maximum number of groups can reach 26, the number of space points, 150, the number of different material zones, 20. The code is written in ALGOL-60 for the GIER computer, and in addition to high speed and drum memories it requires two magnetic tape units. The code uses data averaged for the spectrum and zones by other programs. The second code (TEINTRA) solves the one-dimensional, integral equation of neutron transport in spherical or cylindrical geometry in the multigroup approximation for the critical problem. TEINTRA can solve problems with a number of groups and a number of space points no greater than 60 (separate points). The code is written in ALGOL-60 for the GIER computer, and in addition to high speed and drum memories it also uses two magnetic tape units. The input data are the same as for EWA-TAPE. 7 references. (auth)

52457 (JPRS-48331, pp 139-46) CALCULATION OF HETEROGENEOUS EFFECTS IN FAST-NEUTRON CRITICAL ASSEMBLIES. Cermak, J. Translated from pp 126-32 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 2, Obninsk, 1967.

A method for calculation of the heterogeneous effect due to various distributions of material in an assembly is presented. The heterogeneous structure is presented in the form of a laminar lattice consisting of alternating layers placed perpendicular to the assembly axis. Practical application of this method is shown by numerical calculation of the heterogeneous structure effect on the asymptotic buckling of a laminar reactor assembly with alternating layers of ^{235}U and ^{238}U. (auth)

52458 (JPRS-48331, pp 147-70) UTILIZATION OF PERTURBATION THEORY TO CALCULATE VARIATIONS OF COMPLEX FLUX AND IMPORTANCE FUNCTIONALS. Zaritskii, S. M. Translated from pp 133-53 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 2, Obninsk, 1967.

A method of obtaining perturbation theory formulas for variations of linear and linear-fractional functionals of neutron flux

and for variations of bilinear-fractional functionals of neutron flux and importance is presented. The variations of the linear and bilinear functionals are expressed in terms of the difference in the functionals distinguished by only one of the cofactors of the expression under the integral sign. (auth)

52459 (JPRS-48331, pp 171-6) REVIEW OF THE EXISTING COMPUTATIONAL PROGRAMS FOR FAST NEUTRON REACTORS. Barz, G. U.; Reiche, H. Translated from pp 154-9 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 2, Obninsk, 1967.

The computer programs used by the Central Institute of Nuclear Research for fast reactor physics calculations are described briefly. Programs include: one- and two-dimensional multigroup codes, fast reactor behavior during extended operation, burnup and refueling codes, and stability and dynamics codes. (H.D.R.)

52460 (JPRS-48331, pp 177-98) ANALYTICAL METHOD OF CALCULATING HETEROGENEOUS CYLINDRICAL NUCLEAR REACTORS. Shikhov, S. B.; Davydov, V. I. Translated from pp 160-76 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 2, Obninsk, 1967.

An analytical method for criticality calculations on multi-region cylindrical heterogeneous reactors in the P_1-multigroup approximation is discussed. (H.D.R.)

52461 (KFK-743) CALCULATION OF HETEROGENEOUS EFFECTS IN PERIODIC CELL-STRUCTURE OF THERMAL AND FAST NUCLEAR REACTOR. Wintzer, Detlev (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). Jan. 1969. 52p. (In German). (EUR-3725). Dep.

The basic equations for the determination of the collision probability distributions for calculating position- and angle-dependent neutron fluxes in reactors are given. Use of the cell concept for mathematically simulating physically occurring heterogeneities is discussed. The reaction coefficient which is used to simplify the evaluation of the integral in the expression for the neutron flux is defined; mathematical procedures used in evaluating the reaction coefficient are discussed. The procedures and results are illustrated by a sample problem. Diffusion corrections and heterogeneity corrections for the cross sections are discussed. Approximation methods for various geometries are described. Heterogeneity effects on neutron flux and reactivity are summarized. Data are shown graphically. 29 references. (M.L.S.)

52462 (KFK-781/I) NUMERICAL SOLUTION OF THE POSITION-DEPENDENT DYNAMIC EQUATIONS FOR FAST BREEDER REACTORS USING A VARIATIONAL PRINCIPLE. Kessler, G. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Aug. 1968. 123p. (In German). (EUR-3957). Dep.

The time-, position-, and energy-dependent multigroup neutron diffusion equations are formulated for fast breeder reactors; boundary conditions are specified. Heat transfer equations and boundary conditions for fuel-to-coolant heat flow are given. The feedback equations for the fuel, cladding, coolant, and structural materials are listed. Methods for solution to the position dependent kinetic equations are discussed; the Kantorovitch variational principle is described in detail. The systems of differential equations for the time function of the nonstationary multigroup neutron flux and precursors are formulated. Application of the Kantorovitch variational principle to the solutions of these equations is detailed. The calculational model used as a sample problem for illustrating the variational solution is described. Neutronics parameters are tabulated. Results of power distribution, reactivity, and neutron flux calculations are described; data are shown graphically. 61 references. (M.L.S.)

52463 (KFK-846) CONSISTENT TREATMENT OF THE INFLUENCE OF THE NEW α-VALUE OF ^{239}Pu ON NUCLEAR SIZE WITH CONSIDERATION OF THE PLUTONIUM EQUILIBRIUM ISOTOPIC COMPOSITION. Kiefhaber, E. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). Sept. 1968. 7p. (In German). (EUR-4152). Dep.

The equilibrium plutonium isotopic content (Pu_∞) is calculated for a steam cooled fast breeder reactor by means of the so-called null-dimensional model. Results of calculations of new Pu_α (σ_c/σ_f) values are compared with old Pu_α values. Effects of Pu_∞ on reactivity coefficients are evaluated for the steam cooled fast breeder; breeder efficiency is compared for old and new Pu_α values. (M.L.S.)

52464 (RCN-110) STOCHASTIC DETERMINATION OF NEUTRONIC COUPLINGS IN REACTORS BY CORRELATION AND PROBABILITY TECHNIQUES. Dalfes, Abdi; Tuerkcan, Erdinc (Reactor Centrum Nederland, Petten). June 1969. 55p. Dep. CFSTI (U. S. Sales Only).

The equation relating the correlation matrix of counters located at suitable positions in a subcritical reactor is set up following the theory of branching processes. Instead of solving the matrix equation, the correlation matrix of the counters is processed according to this equation in order to obtain the reactor matrix whose diagonal elements are related to the subcriticality of each region and whose off-diagonal elements are related to the coupling between them. Concurrently with the classical method, a probability method of computation is proposed for the processing of the data to determine the correlation matrix. Experiments have been performed in the Argonaut-type Low Flux Reactor with two-slab and annular cores, by using two or three neutron counters. Results are processed digitally and interpreted according to the techniques outlined. The elements of the reactor matrix, mentioned above, are found in most cases with a reasonable accuracy in a measuring time of a few minutes only. (auth)

52465 (UJV-2225-R) HOMOGENEZATION OF ABSORBER HETEROGENETICS. Kriz, Z. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). [1967]. 17p. (In Czech). Dep. CFSTI (U. S. Sales Only).

The influence of the control rod system of a multiregion reactor is calculated by cell method in two-group approximation. New boundary conditions on the cell boundary are used. The fast and thermal neutron current for the homogeneous cell is considered with the same radius as the control rod cell. The new two-group equivalent parameters L_h^2, τ_h, p_h and k_∞^h are obtained as a solution of a system transcendental equations. The calculation program is described and compared with results of other calculation methods. 7 references. (auth)

52466 (WAPD-TM-893) APPROXIMATE $J(\theta,\beta)$ FUNCTION (LWBR DEVELOPMENT PROGRAM). Steen, N. M. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Aug. 1969. Contract AT(11-1)-Gen-14. 22p. Dep. CFSTI.

A fast and accurate method of approximating the $J(\theta,\beta)$ function for a single resonance, a rapid method of averaging over resolved resonance levels by use of this approximate J function, and a recently developed quadrature scheme of the Gaussian type are described. The approximate J function has been tested on that portion of the θ,β plane for which $\beta \geq 5.0 \times 10^{-5}$ and $\theta \geq 5.0 \times 10^{-4}$. On this domain typical relative errors incurred in $J(\theta,\beta)$ are 0.25 percent or less, and the maximum relative error for any (θ,β) pair is 2.2 percent which is encountered at an extreme value of $\beta = 0.5 \times 10^{-4}$. The technique for J function averaging produces relative errors less than 0.10 percent for cases of practical interest. 8 references. (auth)

52467 OPTIMIZATION OF PHYSICAL CHARACTERISTICS OF NUCLEAR REACTORS. Khromov, V. V.; Kuz'min, A. M.; Kashutin, A. A. At. Energ. (USSR), 27: 186-8(Sept. 1969). (In Russian).

The iterative solution of a perturbation formulation of reactor control problems is described. Use of linear programming methods are also discussed. The few-group diffusion-theory program is described. Applications of the program are illustrated by sample problems which calculate the breeding ratio, atom densities, and reactor dimensions. (TSS)

52468 PRESSURE PULSE MODEL FOR TWO-PHASE CRITICAL FLOW AND SONIC VELOCITY. Moody, F. J. (General Electric Co., San Jose, Calif.). J. Heat Transfer, 91: 371-84 (Aug. 1969).

Pressure pulse transmission in a flowing mixture provides the basis for a theoretical formulation of two-phase critical flow and sonic velocity. Homogeneous and separated phases are considered, showing that phase pattern plays an important role in pulse transmission. Graphs are presented for critical flow and sonic velocity of steam-water mixtures, based on no phase change or heat transfer across the pulse. The model predicts most available data with homogeneous and separated phase patterns and suggests quality ranges for which each pattern applies. (auth)

52469 CALCULATION OF THE MULTIGROUP SPACE-DEPENDENT REACTOR TRANSFER FUNCTION USING THE SPATIAL EIGENFUNCTION EXPANSION METHOD. Obradovic, D. Bull. Boris Kidric Inst. Nucl. Sci., 19: Nucl. Eng., No. 3, 19-30(Nov. 1968).

The spatial eigenfunction expansion method is used to solve the multigroup time-dependent diffusion equation when the absorption cross-section in the thermal group is a function of time. An expression for the multiregion reactor transfer function is obtained.

Some numerical results for two energy groups are also presented. 14 references. (auth)

52470 SPECTRAL PROPERTIES OF A MULTIGROUP TRANSPORT OPERATOR WITH DELAYED NEUTRONS IN PLANE GEOMETRY. Mika, J. (Inst. of Nuclear Research, Swierk, Poland); Obradovic, D.; Stankiewicz, R. Bull. Boris Kidric Inst. Nucl. Sci., 19: Nucl. Eng., No. 5, 37-45(Nov. 1968).

Spectral properties of the multigroup transport operator, with delayed neutrons being present, are analyzed for application to the lumped-parameter-systems approach to reactor dynamic analyses. The multigroup time dependent transport equation is formulated for a uniform infinite slab surrounded by a vacuum. Spectral properties of the transport operator are derived. The time-dependent transport problem is investigated for the initial value conditions. 18 references. (M.L.S.)

52471 MAXIMUM LIKELIHOOD METHOD, A MODERN EVALUATION METHOD. Weise, L. (Kernforschungsanlage, Juelich, Ger.). Kerntechnik, 11: 457-62(Aug. 1969). (In German and English).

An introduction into the maximum likelihood method of statistical analysis for occurrences is presented. Results are compared to the least squares method. (auth)

52472 ADJOINT EQUATION IN SOURCE-SINK METHOD. Kaneko, Yoshihiko (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Sci. Technol. (Tokyo), 6: 540-2(Sept. 1969).

Adjoint equations for the source-sink method of solution to homogeneous reactor kinetic equations are derived. These adjoint equations are based on a one group model with a slowing down kernel and on a two group model. A Green's function technique is applied to the adjoint equations with boundary conditions. Validity of the equations is verified. (M.L.S.)

52473 REMARK ON THE THREE-TIME-POINT ROSSI-α METHOD. Furuhashi, Akira (Tokyo Inst. of Tech.). J. Nucl. Sci. Technol. (Tokyo), 6: 343-6(June 1969).

Use of the time-asymmetry characteristics of neutron count trios in conjunction with the Rossi-α techniques is described. Equations for the counting probability of these trios are formulated; expected frequency of observation of count trios is shown as a function of count trio width. (M.L.S.)

52474 REACTIVITY ANALYSIS BY SPECTRAL CORRECTED GARELIS–RUSSEL METHOD. Aizawa, Otohiko (Tokyo Inst. of Tech.). J. Nucl. Sci. Technol. (Tokyo), 6: 498-507(Sept. 1969).

A series of reactivity measurements has been performed in a subcritical assembly using pulsed neutron source. The study is aimed at gaining information on the differences in the neutron population decay curve caused by differences in energy response of the detector used in the measurement. A scheme is proposed for compensating for differences in observed neutron fluxes. Comparison with experimental results is given, showing that, by means of the proposed correction, the calculated reactivity can be made independent of both detector position and detector type. To obtain meaningful values of reactivity without making use of this spectral correction, detectors with only epithermal response should preferably be used, which should be installed in the reflector region. 14 references. (auth)

52475 LOG SCALED NUCLEAR REACTOR SIMULATOR. Yao, Shi-chune; Yang, Teh-li; Ma, Pu-yuan (National Tsing Hua Univ., Hsinchu, Taiwan). Ho Tsu K'o Hsueh, 6: No. 3-4, 57-66(Apr. 1969).

A Log Scaled Simulator is described which covers 8 decades of the neutron density. The temperature feed back equation was derived and converted into log form together with kinetic equations. This simulator was prepared with parameters obtained from THOR (Tsing Hua Open Pool Reactor). 3 references. (auth)

52476 STUDY OF REACTOR KINETICS BY DIGITAL AND ANALOG COMPUTATIONS. Huang, Lung-rui; Ma, Pu-yuan (National Tsing Hua Univ., Hsinchu, Taiwan). Ho Tsu K'o Hsueh, 6: No. 3-4, 23-37(Apr. 1969).

With the latest delayed neutron data, an electronic kinetics simulator has been made to provide rapid answers for the reactor response to various inputs of reactivity changes. Fortran codes are programmed for the IBM-1620 digital computer to calculate the analytic solutions. The comparison of both results justifies the accuracy of the simulator. 10 references. (auth)

Experimental Applications

52477 (AAEC/TM–504) A DIGITAL COMPUTER PROGRAM FOR APPLYING THE KOLMOGOROV–SMIRNOV TESTS OF SIMILARITY TO TWO SAMPLE POPULATIONS. Gatt, F. C. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). July 1969. 14p. Dep. CFSTI (U. S. Sales Only).

A Fortran IV digital computer program was prepared for estimating the similarity between two parent population distribution functions, using the Kolmogorov-Smirnov test which is based on the maximum difference between two sample cumulative distributions. The similarity of the functions is determined by a percentage level of significance. The program is written for the IBM 360/50H computer. 3 references. (auth) (Australia)

52478 (AEEW-R-586) AN EXPERIMENTAL STUDY OF THE INTEGRAL PROPERTIES OF ^{235}U AND ^{239}Pu IN AN INTERMEDIATE ENERGY SPECTRUM, AND COMPARISON WITH THEORETICAL PREDICTION. Fox, W. N.; King, D. C.; MacBean, I. J.; Pitcher, H. H. W.; Sanders, J. E.; Small, V. G. (Atomic Energy Establishment, Winfrith (England)). Mar. 1968; Reprinted Apr. 1969. 76p. Dep. CFSTI (U. S. Sales Only). UK 11s.

Integral experiments designed to provide a sensitive test of the ^{235}U and ^{239}Pu cross sections spectrum-averaged over the intermediate energy range from 10 eV to 10 keV are described. The measurements were made in a small test region of near-unit k-infinity installed in the zero-power reactor HECTOR. Results of the measurements are compared with theoretical calculations. (H.D.R.)

52479 (INR–1045) TIME MEASUREMENTS IN THE REACTOR SYSTEMS. Chwaszczewski, S. (Institute of Nuclear Research, Warsaw (Poland)). 1968. 108p. (In Polish). Dep. CFSTI (U. S. Sales Only).

Pulsed neutron measurements and their interpretation in critical assemblies are presented. The theory and measurements of the reactor kinetic parameters using the analysis of the statistical properties of the count sequence from the neutron detector placed in a reactor are described. The theory and measurements of the neutron slowing down and diffusion parameters in moderating media using a pulsed neutron source are presented. Experimental equipment used in the described measurements is described. (auth)

52480 (Y-DR-11) CALCULATED CRITICAL RADII FOR BARE SPHERES OF URANYL NITRATE–NITRIC ACID SOLUTIONS AND URANIUM–WATER MIXTURES. Magnuson, D. W. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). Mar. 15, 1969. Contract W-7405-eng-26. 6p. Dep. CFSTI.

Criticality calculations were performed to show the effects of changes in the isotopic content and of changes in nitric acid content on the critical sphere radii for various uranium concentrations. The atomic densities for the solution components, calculated bare critical radii, and changes in critical radii are presented. (H.D.R.)

52481 CRITICAL MASS OF A WATER-REFLECTED PLUTONIUM SPHERE. Smith, David R.; Geer, William U. (Los Alamos Scientific Lab., N. Mex.). Nucl. Appl. Technol., 7: 405-8(Nov. 1969).

The critical mass of a water reflected sphere of high purity alpha-phase Pu was measured. The experimental arrangement and detector calibration is described. Measurements were made on a 5546 g sphere with a diameter of 8.126 cm and a density of 19.74 gm/cm^3. The Pu composition was 94.5% ^{239}Pu and 5.18% ^{240}Pu. Extrapolation of the data indicates a critical mass of 5790 g for the experimental composition or 5430 g for pure ^{239}Pu. (H.D.R.)

Reactor Components, Fuels, and Accessories

Refer also to abstracts 49881, 49883, 49884, 49886–49891, 49896, 50002, 50005, 50011, 50118, 50144, 50216, 50977, 50978, 50980, 50982, 50989, 51010, 51028, 51039–51041, 51043, 51082, 51089, 51090, 51104, 51105, 51142, 51146, 51413, 51857, and 52305.

52482 (AGC–4190) STRESS WAVE EMISSION AND FRACTURE OF PRESTRESSED CONCRETE REACTOR VESSEL MATERIALS. Green, A. T. (Aerojet-General Corp., Sacramento, Calif.). June 1969. Contract W-7405-eng-26; Subcontract 3118. 105p. Dep. CFSTI.

For Oak Ridge National Lab., Tenn.

The applicability of using stress-wave emissions to detect the failure and progression of failure in cylindrical concrete specimens is evaluated. Stress-wave-emission data obtained during these tests have provided a description of the time relationship between the onset and continuing failure process. Cylindrical con-

crete specimens were tested to failure under compressive and splitting tensile loads, in accordance with ASTM specifications, while stress-wave-emission data were monitored and recorded on magnetic tape. Twelve concrete test cylinders (6-in. by 12-in.), three sets of four each, made with limestone, chert, and graywacke aggregates were tested. One mortar model prestressed pressure vessel and a mortar compressive specimen were also monitored during failure tests. 13 references. (auth)

52483 (APDA-236) QUARTERLY TECHNICAL PROGRESS REPORT ON AEC-SPONSORED ACTIVITIES, JANUARY-MARCH 1969. (Atomic Power Development Associates, Inc., Detroit, Mich.). Contract AT(11-1)-865. 50p. Dep. CFSTI.

Tube wastage by sodium-water reactions in steam generators was examined. Preliminary results are presented for the first of a series of tests on the phenomenon of decreasing metal wastage with increasing leak rate. Instrumentation for acoustic data to be taken during the test series is described. Progress in impurity monitoring and analysis in sodium coolant is summarized. The test program and equipment for evaluating the hydrogen detector are described. Schematic diagrams of the hydrogen detector test loop and gas flow system are included. (H.D.R.)

52484 (CEA-CONF-1296) SOME EXPERIMENTS CONDUCTED AT FONTENAY-AUX-ROSES ON OXIDE FUELS. Mikailoff, Hubert; van Craeynest, Jean Claude; Lallement, Robert (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). [1968]. 12p. (CONF-690512-2). Dep. CFSTI (U. S. Sales Only).

From 71st Annual Meeting of the American Ceramic Society, Washington, D. C.

Experiments on low density UO_2-PuO_2 are described. In pile and out of pile measurements on the influence of density and stoichiometry on the performances have been made. Some effects of the density on microstructure, gas release and in pile performance are presented. (auth)

52485 (GAMD-9375) STIFFNESS OF A LAMINATED ELASTOMERIC BEARING. Smith, P. D. (Gulf General Atomic, Inc., San Diego, Calif.). May 14, 1969. Contract AT(04-3)-167. 27p. Dep. CFSTI.

A method has been given which will provide reasonable analytical values for the stiffness of a laminated neoprene bridge bearing. It is believed that the formulas presented here represent the best approximation obtainable without resorting to a three-dimensional elastic analysis. Test values, if they exist, are to be preferred, but, in the absence of test data, these formulas provide adequate information for design calculations. The formulas are summarized. 4 references. (auth)

52486 (GAMD-9404) DYNAMIC ANALYSIS OF AN ELASTOMERIC PRESTRESSED CONCRETE REACTOR VESSEL SUPPORT. Smith, P. D. (Gulf General Atomic, Inc., San Diego, Calif.). June 3, 1969. Contract AT(04-3)-167. 27p. Dep. CFSTI.

Elastomeric bearing pads to be used for supporting a large prestressed concrete pressure vessel and protecting it from seismic stresses are analyzed. Laminated neoprene and steel bearing pads are shown to be effective. The dynamic response by use of the SHAKE computer program is described. Four cases, each with different support flexibility assumptions, are analyzed. 6 references. (D.C.C.)

52487 (JPRS-48331, pp 651-7) RESULTS OF A STUDY OF CERAMIC NUCLEAR FUEL IN CZECHOSLOVAKIA. Podest, Milan. Translated from pp 569-75 of Simpozium SEV: Sostoyanie i Perspektivy Rabot po Sozdaniyu AES s Reaktorami na Bystrykh Neytronakh, Sbornik Dokladov, Tom 2, Obninsk, 1967.

The processes and procedures investigated in the preparation of UO_2 powders and for the production of UO_2 pellets by sintering are briefly reviewed. (H.D.R.)

52488 (LIB/Trans-209) BURNOUT DETECTOR REALISATION. Herzberger, P.; Morin, R. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Translated by E. R. Corran (Australian Atomic Energy Commission Research Establishment, Lucas Heights), from report EUR-362. 48p. Dep. CFSTI (U. S. Sales Only).

An abstract of this paper, prepared from the original language, appeared as NSA 17: 34207. (B.G.D.)

52489 (RT/FI-(69)20) DETERMINATION OF THE SELF-SHIELDING PROPERTIES OF GADOLINIUM IN ALUMINA AND NATURAL URANIUM DIOXIDE MATRICES. Arcipiani, B. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Feb. 26, 1969. 38p. Dep. CFSTI (U. S. Sales Only).

Small samples consisting of an Al_2O_3 or natural UO_2 matrix containing powder or microspheres of Gd_2O_3 and ZrB_2 were oscillated in the center of the reactor RANA. The experimental results were interpreted in terms of the self-shielding parameters of the poison. 8 references. (auth)

52490 (UJV-2153-R) THERMAL CALCULATION OF A TUBULAR FUEL ELEMENT WITH A GIVEN RADIAL THERMAL NEUTRON FLUX. Halouzka, M.; Pecha, P. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). Mar. 1969. 37p. (In Czech). Dep.

A method for thermal calculation of a divided tubular fuel element has been modified in such a way that it is now possible to use any chosen radial distribution of the thermal neutron flux. It is now also possible to include some effects of the vertical division of the fuel element. The programme in "Gier-Algol" has been used to modify the geometry of a fuel-element which consists of two concentric tubes as determined by previous optimization. The purpose of the modification was to achieve equal maximum temperatures on all can-surfaces and to achieve the maximum thermal output from the fuel element. The radial distribution and spectrum of thermal neutrons have been found from the transport-equation using the first flight collision probability. Programmes previously prepared were used, and small changes in the geometry of the fuel element and reactor-cell on the neutron flux distribution were studied. (auth)

52491 (WCAP-3017-6089) YANKEE CORE EVALUATION PROGRAM QUARTERLY PROGRESS REPORT FOR THE PERIOD ENDING MARCH 31, 1969. Stanutz, R. N. (Westinghouse Electric Corp., Pittsburgh, Pa. Nuclear Energy Systems Div.). May 1969. Contract AT(30-1)-3017. 32p. Dep. CFSTI.

Two advanced SENA-type fuel assemblies were irradiated in Yankee Core V. The assemblies consisted of a 16 by 16 array containing 239 Zircaloy-4 clad fuel rods. Stereo-microscopic examination, dimensional measurements, gamma scanning, and leak testing were performed on 9 rods removed following an estimated burnup of 13,500 MWD/MTU. No defects or anomalous conditions were observed. (H.D.R.)

52492 REACTOR SHIELDING. Rastoin, J. pp 295-384 of Genie Atomique. Tome II. Saclay, France, Institut National des Sciences et Techniques Nucleaires. Paris, Presses Universitaires de France, 1968. (In French).

The factors to be considered in the calculation of reactor shielding are analyzed in detail. An example is given of the calculation of the reactor shielding for a graphite reactor. The Monte Carlo method is alsc described. (J.S.R.)

52493 OPERATION AND CONTROL OF A REACTOR. Bouchicot; Ramard. pp 159-88 of Genie Atomique. Tome II. Saclay, France, Institut National des Sciences et Techniques Nucleaires. Paris, Presses Universitaires de France, 1968. (In French).

As a reactor is a complex device and essentially unstable, it is necessary to possess continuous data on its operation to permit safe utilization under the desired conditions. The control apparatus are distinguished from the operational apparatus. Neutron detectors and their associated chains are studied by defining their areas of application and by giving their principal characteristics. Modifications in the neutron flux are generally made by the control rods. Their operation is studied. (tr-auth)

52494 IMPROVEMENTS IN CONTROL AND REGULATING ELEMENTS FOR CONTROLLING THE REACTIVITY IN NUCLEAR REACTORS. (to Kernforschungsanlage Julich GmbH). British Patent 1,165,968. Oct. 1, 1969. Priority date Feb. 26, 1966, Germany.

BORIDES—fabrication of sphere shaped pyrolytic carbon coated mixed, for reactor control elements

REACTOR CONTROL ELEMENTS—fabrication of pyrolytic carbon coated mixed boride sphere shaped particle (D.C.C.)

52495 NUCLEAR REACTORS. Molle, Raoul Desire Joseph; Durranas, Kenneth James (to Societe Anglo-Belge Vulcain S. A.). British Patent 1,164,261. Sept. 17, 1969. Filed Feb. 6, 1967.

Reference is made to means of controlling reactivity in nuclear reactors by movement of neutron absorbers, moderator, or fissile material relative to the reactor core. Some disadvantages associated with present systems of this type are described. In the system described a control member is subjected to the action of a sequence of fluid pulses, the sequence being of variable character so that the rate and direction of movement of the control member can be controlled by varying the character of the sequence of pulses. The character of the sequence of fluid pulses

can be changed by variation of one or more of the main pulse parameters, such as frequency, amplitude, sign, shape and duration. A simple method is thus provided for accurately controlling the rate of movement of neutron absorbers in and outside the reactor core, the absorbers being moved under the effect of a flow of fluid circulating in passages through the core. The direction of fluid flow is controlled by a hydraulically operated valve. Various methods of operating the system are described. (UK)

52496 A SAFETY CLOSURE FOR A MAIN OPENING IN A PRESTRESSED CONCRETE CASING FOR A NUCLEAR REACTOR. (to Societe Franco-Americaine de Constructions Atomiques Framatome). British Patent 1,166,640. Oct. 8, 1969. Priority date Dec. 17, 1965, France.

PRESSURE VESSELS—closures for prestressed concrete, description of dual cover safety

REACTORS—pressure vessels of, description of dual cover safety closures for prestressed concrete (D.C.C.)

52497 COMPUTER-AIDED CALIBRATION OF A FINE AUTOROD. Cohn, Charles E.; Karam, Ratib A.; Marshall, James E.; Van Doorninck, Jacob M. (Argonne National Lab., Ill.). Nucl. Appl. Technol., 7: 342-6(Oct. 1969).

A method for accurate calibration of control rods of very small worth starts with a record of flux versus time produced by moving the rod back and forth between its stops a large number of times. This record is converted to reactivity by an inverse-kinetics calculation. The reactivity is fitted to a series of Legendre polynomials in rod position and a series of Gram polynomials in time, the latter to allow for reactor drift. (auth)

52498 IN-CORE STUDY OF THE MECHANICAL INTERACTION BETWEEN FUEL AND CLADDING. Kjaerheim, G.; Rolstad, E. (OECD Halden Reactor Project, Halden, Norway). Nucl. Appl. Technol., 7: 347-60(Oct. 1969).

Measurements of fuel stack and cladding length changes by means of differential transformer elongation detectors on more than 50 fuel rods irradiated in the Halden Boiling Heavy Water Reactor (HBWR) have resulted in the following general conclusions regarding in-pile dimensional behavior of fuel rods. When a fuel rod is brought to power for the first time, the clearance between pellet stack and cladding will decrease with power due to the larger thermal expansion of the fuel. The radial temperature distribution through the fuel will be parabolic and the originally flat ended cylindrical fuel pellets will therefore change to hourglass shaped bodies with convex ends. The pellet stack will expand freely inside the cladding until at some power level the "corners" of the hourglass shaped, hottest fuel pellets will first touch and then make force contact with the cladding. The force system set up between the fuel stack and cladding will increase with power and affect their dimensional changes so that these are no longer decided by individual thermal expansion alone. The mechanical interaction will increase with power and the cladding will finally be permanently deformed to fit the external dimensions of the pellet stack, and the fuel rod will at this point look like a bamboo-rod. Mechanical interaction will later take place only if the power is increased beyond its previous level, as long as fuel swelling has not affected the fuel outside dimensions. Knowing that the cladding material loses ductility because of irradiation damage and chemical attack, the conclusion is reached, therefore, that fuel should be operated hard when new so that the bamboo ridges and other forms of strain concentrations caused by interaction are formed when the cladding is ductile. To avoid further interaction, the power should preferably be tapered off gradually with burn-up so that part of the volume used to accommodate thermal expansion can be made available for the volume increase because of fuel swelling. (auth)

52499 FRACTURE IN SPHERICAL PRESSURE VESSELS. Burdekin, F. M. (Sandberg Consulting, Inspecting, and Testing Engineers, London); Taylor, T. E. J. Mech. Eng. Sci., 11: 486-97(Oct. 1969).

The problem of fracture initiation and propagation from long flaws in spherical pressure vessels is considered from both theoretical and experimental viewpoints. Experimental work was carried out on vessels of 5 ft diameter and ½-in. thickness with a range of initial slit lengths from 3 to 24 in. to determine the pressure for rupture by shear fracture. Geometrical variations were further examined by tests on two vessels of 26 in. diameter and ½ in. and ¼ in. thick, respectively. The vessel tests were instrumented to give detailed behavior local to the crack tip and to indicate the gross deformations occurring. The results were analyzed and found consistent with the theoretical view that fracture in vessels of ductile materials may be controlled by the occurrence of a limit mechanism. For less ductile materials fracture mechanics approaches should be used, with allowances for plasticity and bulging. The approach enables the prediction of critical crack lengths for unstable fracture in full size service vessels provided the relevant material properties are known. (auth)

52500 BELGIAN INDUSTRIAL ACCOMPLISHMENTS IN THE FIELD OF FUEL CYCLE. Tavernier, G. (Belgonucleaire, Brussels). Atompraxis, 15: 153-4; 157(May-June 1969). (In German).

After a short and schematic description of the fuel cycle the various industrial companies active in this field are described. The main accomplishments are cited. (auth)

52501 FUEL SUBASSEMBLY FOR NUCLEAR REACTOR. (to Societe Belge pour l'Industrie Nucleaire, Societe Anonyme). British Patent 1,167,453. Oct. 15, 1969. Priority date Feb. 23, 1967, Belgium.

REACTOR FUEL ELEMENTS—assemblies of rod type, description of web arranged spaced (D.C.C.)

52502 URANIUM VS FOSSIL FUELS: AS AN ENERGY SOURCE. Bell, E. S.; Angebrandt, F. (National Energy Board, Ottawa). Can. Mining Met. Bull., 62: 972-9(Sept. 1969).

Alternative fuels for electric power generation in Canada are considered. In a publicly owned utility, nuclear stations are economic for base-load generation for unit sizes of 500 megawatts or larger where competitive fossil fuel costs are higher than about 30 cents per million Btu. In British Columbia, Alberta and Saskatchewan, fossil fuels will continue to be in adequate supply at costs lower than 30 cents per million Btu and thus, except for the special case of Vancouver Island, power generation in Western Canada will continue to be the hydraulic and conventional thermal type. In Eastern Canada, fossil fuel prices are likely to be higher than 30 cents per million Btu and most utilities will be able to install units of 500 MW or larger, so that nuclear power plants will provide much of the base-load generation required. Base-load generation comprises about two-thirds of the energy generated by power utilities. By 1990, the total annual electrical energy load will be over 600 billion kWh, with two-thirds of this load in Eastern Canada. Allowing for additional hydraulic resources which may be developed in Quebec, British Columbia and Manitoba, hydraulic generation is forecast to provide a little more than a third of this electrical energy, nuclear generation a third and fossil-fuelled generation about a quarter. (auth)

GENERAL

52503 (COO-1018-1188) DYNAMIC FOCUSING AND PIN-CUSHION CORRECTION CIRCUIT FOR THE ILLIAC III DISPLAY SYSTEM. Franco, Sergio (Illinois Univ., Urbana. Dept. of Computer Science). Aug. 12, 1969. Contract AT(11-1)-1018. 11p. Dep. CFSTI.

52504 (CTC-19) THE SADS PROGRAM: STATISTICAL ANALYSIS OF DATA SUBSETS. Hume, Alfred; Brooks, Alfred A. (Union Carbide Corp., Oak Ridge, Tenn. Computing Technology Center). Oct. 9, 1969. Contract W-7405-eng-26. 345p. Dep. CFSTI.

The SADS program supplies a means for the statistical analysis of medium to large volumes of related alphameric and numeric data. Facilities are provided for recognizing subsets of the data and computing frequency counts, means, standard deviations, and regression analyses. Operation of the SADS program is controlled by a set of instructions written in an Algol-like language designed specifically for this purpose. A variety of constructions are available for declaring and examining data fields, which may be simple or structured. Logical and arithmetic expressions are fully implemented and unlimited nesting is permitted at both the statement and expression level. Field addressing, which may be in terms of pointer words in the data record, is fully checked for invalidities. A means of handling missing data is implemented. User-written FORTRAN functions and subroutines may be called from the analysis program. Comparisons may be written using English words (e.g., disease names) which are automatically looked up in a user-supplied dictionary. A structured field is implemented that is designed specifically for representing and examining repetitive, related data fields (e.g., autopsy data). The list-processing capabilities of the SADS program require that data records be self-describing and contain pointer words which accomplish this purpose. A companion program which creates such records is described in DSEP—A Data Set Edit Program (K-1748). (B.G.D.)

52505 (IN-1274) POLAROGRAPHIC KINETIC CURRENTS FOR THE FIRST-ORDER, ONE-HALF REGENERATION MECHANISM AT SPHERICAL ELECTRODES. Delmastro, J. R.; Booman, G. L. (Idaho Nuclear Corp., Idaho Falls). Sept. 1969. Contract AT(10-1)-1230. 11p. Dep. CFSTI.

The analytical solution for the large potential-step electrode response at a stationary spherical electrode with the first-order, one-half regeneration mechanism was derived by a nonroutine application of the Laplace transformation method. The form of the resulting solution depends on the value of the effective electrode sphericity. (auth)

52506 (LA-4206) IMMERSION SPECTROPHOTOMETRY OF VAPOR-DEPOSITED INTERFERENCE FILMS. Mulford, Ann D.; Ellis, W. P. (Los Alamos Scientific Lab., N. Mex.). June 1969. Contract W-7405-eng-36. 18p. Dep. CFSTI.

The refractive index of magnesium fluoride as determined by the immersion spectrophotometric method is an integrated index which depends on the degree of heterogeneity within the film. This index changes with time because vapor-deposited films undergo aging, a process of recrystallization brought about by the inherent stresses. The foregoing factors can be minimized in films made by very rapid deposition (~15 sec) and then vacuum-stabilized. (auth)

52507 (LA-4222) METHOD OF DESCENT FOR FINDING THE ROOTS OF POLYNOMIALS IN A SINGLE VARIABLE. Motteler, Zane C. (Los Alamos Scientific Lab., N. Mex.). July 23, 1969. Contract W-7405-eng-36. 40p. Dep. CFSTI.

A method for finding the roots of a polynomial and a subroutine for the CDC 6600 embodying the method are described. The algorithm is based upon determining a direction of descent from a given point by examining the first nonzero derivative at that point; rather involved calculations then provide a distance to move in this direction. If the first derivative is nonzero then this method is a modified version of Newton's method. (auth)

52508 (MLM-1646) PROGRAM FOR CALCULATING X-RAY DIFFRACTION INTERPLANAR (d) SPACINGS WITH A PDP-8/I COMPUTER. Seabaugh, P. W.; Eckstein, R. R. (Mound Lab., Miamisburg, Ohio). Oct. 15, 1969. Contract AT-33-1-GEN-53. 13p. Dep. CFSTI.

A PDP-8/I computer program is described, which yields interplanar spacings from measurements made on an x-ray diffraction photograph of a powdered sample of a crystalline material. Use of the small computer located in the laboratory greatly reduces the data flow-through time in comparison with that required in using a large central computer system. (auth)

52509 (ORNL-4392) WALKER BRANCH WATERSHED PROJECT: HYDROLOGIC ANALYSIS AND DATA PROCESSING. Snyder, W. M.; Curlin, J. W. (Oak Ridge National Lab., Tenn.). Apr. 1969. Contract W-7405-eng-26. 63p. Dep. CFSTI.

The processing of data from continuously recording instruments is described for the ecosystems on the Walker Branch Watershed. Recorded rainfall and streamflow records are defined. Inventories and analyses of long-term effects of base-flow on water yield of the streams and chemical, biological, and mineralogical inputs-outputs of the streams are included. (J.C.W.)

52510 (ORNL-TM-2271) WALKER BRANCH WATERSHED PROJECT: OBJECTIVES, FACILITIES, AND ECOLOGICAL CHARACTERISTICS. Curlin, J. W.; Nelson, D. J. (Oak Ridge National Lab., Tenn.). Sept. 1968. Contract W-7405-eng-26. 106p. Dep. CFSTI.

One of the most serious environmental problems facing the eastern U. S. is that of water quality and stream pollution. Small experimental watersheds which define practical ecosystems provide a means for studying the effects of man-caused disturbances on water quality. Walker Branch watershed, a 241-acre forested catchment basin, has been established to provide data on baseline values for unpolluted natural waters, contribute knowledge of cycling and loss of chemical elements in natural systems, and enable construction of empirical models with which to predict the ecological effects of man's activities. The objectives of the project, the facility, and the ecological characteristics of the watershed are discussed. (auth)

52511 (RD/B/N-1468) ATOM TRANSPORT DOWN THERMAL AND ELECTRIC GRADIENTS IN SOLIDS. Hesketh, R. V. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Aug. 1969. 30p. Dep. CFSTI (U. S. Sales Only).

The heat of transport of a diffusing species is, by definition, the flux of heat carried in an isothermal situation by a unit flux of that species; it is the quantity of heat associated with a defect in a matrix. Expectedly, it is proportional to the heat content of the matrix. It is $-(2AkT + 4B\gamma T^2/3)$, where $3k$ is the lattice specific heat, γT is the electronic specific heat, and the constants A and B define the respective volumes from which phonons and electrons are scattered; each constant is a positive pure number, and represents the number of atomic sites of the matrix which lie within the scattering volume surrounding the lattice defect. The scattering process always leads to forces pushing atoms down the phonon or electron energy gradient. For simple solids both A and B are readily calculable; for Sr^{2+} in NaCl an unrefined calculation of A gives the heat of transport to within 0.02 eV of the experimental value, and a free electron calculation of B agrees with the electromigration data on Ag to within 5%; the drift velocity of a coherent marker in the presence of an electric potential gradient $\nabla(V)$ is shown to be $v = -2B\, D_s\, \nabla(neV)/3kT$, where D_s is the self diffusion coefficient, n is the number of free electrons or holes per atom and $-e$ is the electronic charge. The sense of motion of this marker (with respect to the ends of the specimen) is always towards the cathode, and is identical for electron and for hole conduction. The diffusion of vacancies and substitional atoms in a metal placed in a temperature gradient involves both A and B, and the present calculation is sufficiently sensitive to predict the observed difference between the heats of transport of Au in Ag and of Ag in Au. The expression assumes thermal equilibrium between the electron and phonon systems. However, when the concentration of the diffusing species exceeds a few ppM, there is significant disequilibrium, even at 1000°C. It becomes evident when A and B are of widely different magnitudes, and is seen in the experimental data on Co in dilute solution in Cu. (auth) (UK)

52512 (SCL-RR-69-70) TURBULENT HEATING FROM A COMPRESSIBLE BOUNDARY LAYER WITH PRESSURE GRADIENT. Hartley, D. L.; Witze, P. O. (Sandia Labs., Livermore, Calif.). Oct. 1969. Contract AT(29-1)-789. 40p. Dep. CFSTI.

A turbulent boundary-layer heating theory is presented which approximately accounts for the pressure gradient contributions to the integral momentum-conservation equation. The variation of similar treatments of pressure gradient found in the literature is illustrated and discussed. Numerical calculations of boundary-layer thickness and heat-transfer rate are compared with other approximate theories. (auth)

52513 (UCRL-18667(Suppl.)) INDEX TO NUCLEAR CHEMISTRY DIVISION ANNUAL REPORT, 1968. (California Univ., Berkeley. Lawrence Radiation Lab.). Mar. 1969. Contract W-7405-eng-48. 61p. Dep. CFSTI.

A permuted index is given of the keywords and numbers contained in the titles of the papers in the Nuclear Chemistry Division Annual Report, 1968 (UCRL-18667); author's surnames are also indexed. An explanation of how the index was prepared is included. (P.C.H.)

52514 (UCRL-50667) SIMPLE ANALYTICAL MODEL FOR THE DUST DEVIL. Logan, Samuel E. (California Univ., Livermore. Lawrence Radiation Lab.). May 1969. 28p. Dep. CFSTI.

A simple analytical model was developed for prescribing the velocity fields in a dust devil, a small vortex phenomenon common in arid regions. The proposed model has a viscous "inner" region (boundary layer) composed of a Prandtl layer and an Ekman inflow layer and an inviscid "outer" region of cyclostrophic balance. Observations indicated that to a good approximation the outer flow is a Rankine combined vortex. Linearization of the equation of motion allows a solution for the radial and tangential velocities in the boundary layer and for the depth of the layer in terms of two parameters obtainable from the observations: $\alpha(r)$, the inflow angle at the top of the Prandtl layer; and $\eta(r)$, a modified Ekman length determined by the outer flow. The vertical velocity field is then found by application of the continuity equation. The velocity fields were found to resemble a first-order solution by Kuo for convective atmospheric vortices, and compare reasonably with the measurements of Sinclair. (auth)

52515 (UCRL-50674) RESONANT EFFECTS IN THE TIDES IN A NUMERICAL MODEL OF THE ATMOSPHERE. Hardy, John W. (California Univ., Livermore. Lawrence Radiation Lab.). June 2, 1969. 15p. Dep. CFSTI.

Both the diurnal and the semidiurnal components of the traveling wave component of the tides in a numerical model of the atmosphere are shown to have resonant peaks in amplitude. The relative sizes of these amplitudes, an historical problem for the atmosphere, is explained by the relative closeness of the excitation periods for each of these peaks to the excitation period of 24 hr. The two components are also shown to have periods differing from those expected from linear theory. Thus, in the model, nonlinear effects are shown to be significant. (auth)

52516 (UCRL-50683) A USER'S GUIDE TO THE PUBLISHER PROGRAM. Fritsch, Frederick N.; Smith, Virginia C.; Lawrence, J. Dennis (California Univ., Livermore. Lawrence Radiation Lab.). June 11, 1969. 60p. Dep. CFSTI.

A complete user-level description of the capabilities and operation of Publisher, a computer program used to write notes and reports, to update them, and to obtain multiple copies from information on punched cards or magnetic tape. This guide was published with the aid of Publisher and thus provides an illustrative example of the program. (auth)

52517 (UCRL-50684) USER'S GUIDE TO THE PUBLISHER ALTER PROGRAM. Fritsch, Frederick N.; Dickinson, F. Joan; Lawrence, J. Dennis (California Univ., Livermore. Lawrence Radiation Lab.). June 11, 1969. 62p. Dep. CFSTI.

Publisher alter (PubAlt) is an alter routine for the Publisher program. This routine offers a convenient method for correcting and updating Publisher input stored on tape. Information is altered by English words rather than by card. PubAlt offers a variety of alter requests for flexible altering of text and sentinels. PubAlt may be used with any version of the Publisher program and may be interchanged between the CDC-3600 and CDC-6600 at any time. (auth)

52518 (WAPD-TM-790) MANE1: A FORTRAN-IV DIGITAL COMPUTER PROGRAM TO SOLVE A RECTANGULAR MAGNETIC NETWORK. Guerdan, D. A.; Marlowe, O. J. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Sept. 1969. Contract AT(11-1)-Gen-14. 25p. Dep. CFSTI.

The MANE1 program provides a solution to the same magnetic network as did the MO565 (WAPD-TM-557) program. The revised mathematical formulation of the problem is described. (auth)

52519 PROCEEDINGS OF THE NSF-SINB CONFERENCE ON SCIENCE, TECHNOLOGY, AND STATE GOVERNMENT, LOUISVILLE, KENTUCKY, SEPTEMBER 19-20, 1968. Atlanta, Southern Interstate Nuclear Board, 1969. 238p. (CONF-680957).

Three panel discussions were presented including; State Government in the Technological Age, Approaches to Implementation of State Science and Technology Programs, and Science Program Management. Two other general topics for which papers were presented were Science and Technology in Economic Development and Science, Technology, and Social Problems. (E.R.B.)

4497